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The Pennsylvania Horticultural Society

Presented by

Alan Crawford
GARDEN WORK
GARDEN WORK
A PRACTICAL MANUAL

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With a Supplement on the SCHOOL
GARDEN and GARDENING CLASS

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INTRODUCTION

Gardening is one of the healthiest and most invigorating of all hobbies or occupations.

Further, one cannot cultivate the soil, sow seeds, tend seed beds, or watch the growth of plants without becoming conscious of a great unseen power, a power undefinable, yet manifestly present to all who take up this occupation. When we look more minutely into the construction of plants, examine the different parts under a microscope, study the work allotted to each, and the relations between the parts, we cannot but wonder at the perfect adjustment of each and every part, all so intricate, and yet so perfect. How could such perfection be brought about? we ask. As we begin to think, our minds become broader, and the more we study our plants the more interested we become in trying to unravel the sublime secrets of Nature. The cares and trials of life, which seem, at present, to sap our whole strength, and leave us listless, gradually fade away before this all-absorbing study.

Let every young gardener make up his mind to leave his profession better than he found it, and work with that aim in view. He will have discouragements and take false steps, but if he keeps his aim fixed before him, progress is sure to be made. He may not reach his final
goal, but he will have done something towards lifting his honourable occupation to that high level which it undoubtedly deserves.

How is the young gardener to prepare himself thoroughly for his life's work? Before commencing his career he should count the cost. I remember asking a would-be gardener if he had a strong desire to master all the difficulties that he would most certainly have to face. His reply was: "I like to work among the flowers". Most of us like the beautiful side of anything. I endeavoured to point out to him some of the difficulties he would have to overcome, of the mental as well as of the bodily work, and that, instead of always working among beautiful flowers, a great deal of the work would be hard and monotonous. I also told him that the results of patient work would not always be successful, and that when striving hard, and doing our best, we might often be misunderstood by our employers. He did not become a gardener.

I remember, too, when I was about to commence my gardening career, my master asking me if I wished to become a gardener. "Yes," was my reply. "But are you quite sure?" he queried. On my replying in the affirmative, he gave me some idea of the difficulties I should have to surmount if I wished to succeed. On the other hand, he gave me some faint idea of the infinite pleasure I should derive from my work if I put my whole heart into it. When he knew my mind was thoroughly made up, he diligently strove for the next three years to fit me for my future career, by ensuring a good and solid foundation.
In after years I often think of the great amount of care he unsparingly bestowed on me, care that was not always appreciated at the time, yet afterwards fully understood. I often think that if masters were more painstaking and thorough, if they weeded out the unsuitable to begin with, and made the most of those who remained, it would be better for our profession. Many masters, however, while paying great attention to the practical, often neglect the theoretical. The latter must entail many hours of hard study. The great tendency, however, at present, is for the young gardener to spend too great a proportion of his leisure time in seeking pleasure, and too little in the study of the principles underlying his practical operations.

A prominent man in the horticultural world once said that he was grieved to see the little interest his apprentices took in private study. After their day's work was done, it was amusement of one kind or another that claimed their whole attention. Can one wonder then, at our worthy profession deteriorating, and that the vulgar name of “clodhopper” is applied to a gardener? By our indifference we have earned it. We must now “wake up” and alter this. It will not be an easy matter, as prejudices die hard, but it can, and I am confident will, be done.

Let us consider first what subjects we ought to study, and why.

A. Geology, to enable us to understand the nature of soils and their composition.

B. Botany, the life of a plant—with its sub-divisions: Morphology, the appearance; Anatomy, the construction;
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Physiology, the mode of feeding; and Reproduction, the method of multiplication.

C. Chemistry, which tells us of the various foods, the state of the soils, the method of treating diseases, and how we can rid our plants of their many insect foes.

D. Bacteriology, because it is by the action of the lowly plant organisms—Bacteria—that practically all our plant foods in the soil are rendered available for use by the plant. It is also by the action of bacteria that our waste vegetable matter is changed into the very valuable manure—"vegetable mould".

E. Entomology, because it is by the action of innumerable insect friends that we obtain our fine crops of fruits and seeds so cheaply. It is also by the action of many insects that thousands of pounds' worth of damage is done every year to our garden crops.

F. Meteorology, because the weather plays such an important part in the welfare of our gardens. By judging the weather correctly, we might save many pounds annually, by knowing when advantageously to sow our seeds, plant our young plants, and cover the more tender ones, which require protection in severe weather.

Such a curriculum as stated above may to some seem appalling. This is not so. If we commence scientific training when we start gardening, and proceed step by step, the magnitude of the task very soon disappears, and by the time we are ready to take our first charge as head gardener, we shall be qualified, both practically and scientifically, to fill our position with competence.

To those living in the country, away from the centres of learning, such a training may seem a great difficulty.
In this age of excellent correspondence classes and private tuition the difficulty is very easily surmounted, and I am sure, if the demand were made for such a training, the Board of Education would find a way to supply the necessary want.

Much has already been done by the Government in this direction by encouraging the appointment of County Instructors of Horticulture and Nature Study, whose duty it is to give instruction in these subjects, supervise the teaching of Gardening in elementary schools, and give lectures on Nature Study to school teachers. Such appointments are creating a demand for thoroughly practical and scientifically trained young gardeners, who are able to impart in a proper manner the knowledge they have diligently acquired.

This now brings me to the subject of "School Gardening". What a great power this may become in our country if properly taught! Boys and girls acquire a sound training in the methods of cultivating the various garden crops, and also some idea of the principles underlying their practical operations. It is really encouraging to watch the effect on children of the teaching of gardening. How intently they listen, as the mystery of the life and growth of the plant is unfolded to them, as the rotation of crops is explained; and when they actually see the advantage or disadvantage of certain methods of cropping, their delight and enthusiasm are unbounded. The vast majority of the children attending the gardening classes, however, will only use their knowledge in the cultivation of their own gardens or allotments, but those who take up gardening as a future
career will have their appetites whetted, as it were, for more study. Some may allow their early training to lapse, but I am sure others will be so stirred by their first experience that they will follow it up by a deeper study of the mysteries of plant life, and this will raise up a body of men such as the gardening profession has never yet known. Not that I wish to cast any slur upon the splendid men we have had and still have, men whose names will ever live in the gardening world, but one must admit that there is still a majority of gardeners who are, and always have been, indifferent to the welfare of their profession as a whole.
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CHAPTER I

The Soil

The soil is the all-important matter in gardening, therefore it is necessary to have some knowledge of the nature of soils, and the conditions necessary for the successful cultivation of plants, before proceeding with other subjects.

Geology teaches us that primarily our earth was a molten mass, revolving in space. In the course of ages this mass cooled down on the outside. Rocks were formed, and then again as time rolled on, the rocks were acted upon by the weather and a gradual decay set in. Pieces of these rocks were broken off, and these in turn were acted upon by climatic influences. All rocks and stones are more or less porous. The pores absorb moisture. During the winter, however, the water, in the course of becoming frozen, expands, and the tiny particles of rock split asunder, fall off, and so, slowly but surely, soil is formed. This action is constantly carried on, on all stones and rocks. The closer the pores the slower the action and the finer the resultant soil.
But there are other ways in which the rocks and stones are slowly being converted into soil. In tropical countries, where frost is unknown, the varying changes of temperature have a somewhat similar, though slower, effect. The sandstorms, by their violence, are gradually grinding the sand into finer particles and bringing down loose pieces of rocks, which, in their turn, are gradually reduced to minute fragments. The sea, too, in its ceaseless action, is an active soil-maker. Sandy soil is being constantly formed, owing to the action of the waves on the surrounding land. Similarly, a river, by its current, is gradually grinding rocks or stones that by many means are deposited in its bed. This powdered rock is either carried down to the sea or washed up on the banks, thus forming a deposit of rich mud. This is most plainly seen after a river has overflowed its banks. Usually, when the water regains its normal level, a thick layer of mud is found to have been deposited on the surrounding country. Again, the traffic on the roads and the heavy rains all help in the making of new soils.

This, however, is only one part of the soil, and is called the mineral or inorganic part, formed from bodies that have no organs. Another very important part of our fertile soils is the vegetable and animal, or, as it is called, the organic portion of it.

Lowly forms of plant life begin to grow on the earth's surface (plants, maybe, that are of a low organized form), the weaker ones die, the hardier continue to grow, ultimately producing reproductive organs, and in their turn dying too. Their remains gradually decay, and this decaying vegetable matter, mixing with the mineral, or
inorganic, matter, makes the soil richer, and higher forms of plants are thus able to obtain the necessary nourishment requisite for their full development and for the storing up of varying quantities of materials ultimately used as food for the lower and higher order of animals, and also for man. We can thus understand how, in the course of centuries, the soil would gradually become richer and richer, until we get the fertile soils of our farms and gardens.

But not all soils are alike, either in texture or fertility. We will briefly consider some of the principal kinds of soil, and try to find out something about each of them.

A. ALLUVIAL SOIL

This may be taken as the most fertile of all soils. It is that soil which is carried down by rivers and deposited at their mouths, or where the rivers overflow their banks on the lower reaches of their course. It is deposited on the flat fields when the water drains away. The overflowing of the River Nile provides an excellent example of this; it leaves behind a rich deposit of alluvial soil, which is the source of their livelihood to the natives. Now we know that this alluvial soil consists of very finely divided particles, and contains also a great amount of fertilizing matter. As we watch the little streams that are formed on the roads during heavy rain we see straws, particles of manure, &c., being swept along. The tiny streams which also run over the surface of the fields carry considerable quantities of fertilizing matter. All these make their way into the ditches, and thence into
Garden Work

the rivers, and the silt is deposited as before described. We need not wonder now why alluvial soil is such a very fertile soil when we remember that there is so much available plant food in it and such a varied assortment of soil particles.

B. LOAM SOILS

These come next in order of fertility, but they are more important than the alluvial. Whereas the latter are only formed in certain places by the action of rivers, loam soils are fairly general. They may be divided into three classes: loams, clayey loams, and sandy loams.

A clayey loam may contain from 50 to 60 per cent of clay, while a sandy loam contains not more than 30 per cent. A loam, however, may contain from 40 to 50 per cent. These have about equal proportions of very small particles which cling together very closely and are held in a compact mass by a sticky substance called silicate of alumina, and also of coarser and more porous materials. Now the advantages of a loam soil are obvious. First, it retains sufficient moisture for the use of the plants—except in periods of continued drought—through the retentive nature of the finer materials, and yet, through the liberal mixture of the coarser material, it does not hold too much moisture so as to render the roots of plants cold during the spring. The air also is able to have free access to the roots, a most necessary condition for the health of the plant.

A loamy soil is also easy to cultivate, being neither too stiff nor yet too friable.
C. CLAY SOILS

These have above 80 per cent of the finer particles, which are also bound together by silicate of alumina. The obvious disadvantage of this is, that the water is retained in the soil, making it very cold in spring and also preventing the air from getting in to the roots of the plants. In periods of exceptional drought, also, it dries up, but in doing so it contracts to a considerable extent, forming deep fissures, which break the roots of plants growing in it. This causes them to suffer to a great extent. And even when rain comes it is some considerable time before the plants reap any advantage from it; the water runs off the surface into these fissures, down into the subsoil, and then right away beyond the reach of the plant roots. Before any advantage can be gained, the soil must become thoroughly saturated. It then expands, the fissures close up, and the plants get the benefit of the moisture.

A clay soil, however, is often a very rich soil, especially when "improved". The first thing that must be considered in the improvement of a clay soil is to get rid of the superfluous moisture. This is done by draining. A suitable depth for laying the drain pipes is from 18 in. to 2 ft., according to the retentive power of the

![Tile Drain](image1)

![Pipe Drain](image2)
soil, thus carrying away the surface water, which is the special object of draining. The lines of piping should be from 9 to 12 ft. apart. When this is done a liberal supply of ashes, grit, or sand should be added during the process of digging. This tends to make the soil more porous, and will allow the water to pass into the drains. It can be improved, also, by adding about 20 lb. of quicklime per pole and pointing it in. The lime unites with the silicate of alumina, making the whole soil more friable. Sometimes, with the object of improving its physical condition, part of the soil is burned. The action of fire on the clay is to make it easily pulverized. The burnt soil can then be spread on the top and dug in, thus improving the whole. A clay soil is often a very late soil, on account of the excessive amount of water it holds. It takes much more heat to raise the temperature of water 1 degree than it does to raise that of sand 1 degree. Therefore the greater the amount of water in the soil the longer is the soil in being warmed for the germination of seeds and the growth of plants in spring.

Clay soil is very difficult to cultivate, and after rain it is some time before one can work it at all. When it is improved in texture it has many advantages, retaining moisture for a considerable time, thereby ensuring a continuous growth.

**D. SANDY SOILS**

These may have from 80 to 90 per cent of sand, and from 10 to 20 per cent of clay and organic matter. They are generally very poor soils, on account of the very small quantity of organic matter which they contain.
Even the addition of organic matter does not help them much, for as this organic matter is changed into liquid plant food it is washed out of the soil by the rains on account of there not being sufficient clay or fine particles bound together to retain the moisture until the plants are able to take it up.

Sandy soils are very difficult and expensive to improve. A large quantity of broken clay is required. This must be dug into the soil to make it more retentive. A sandy soil is always a very early soil, because of the little water it contains. It warms up very quickly in spring. Seeds sown germinate, and, if there is plenty of rain, plants grow rapidly. In summer, however, unless there is sufficient moisture, the plants suffer and sometimes die from lack of moisture. It is therefore advisable to grow early crops on sandy soils, and to sow as early as possible, so that the roots will go down deeply into the soil before drought sets in. A sandy soil is very easy to cultivate.

E. PEAT SOILS

These are made up to a great extent of vegetable matter derived from decaying plants, together with small quantities of sand or mud which may be washed into the marshy places by streams. Draining is the first operation in the improvement of these soils. In this case the drains may be put in deeper than in the case of clay soil, as this soil is more porous. They may be placed from 3 to 4 ft. deep, and from 15 to 18 ft. apart. When this has been done, a liberal amount of grit may be
added to supply the deficiency of inorganic matter. There are two great classes of peat soils: (a) black peat, which, when treated as above, produces excellent crops of most vegetables, but especially of potatoes and carrots; (b) brown peat, which will not readily respond to any known treatment. This peat has been formed in stagnant bogs where the vegetable acids, not being able to drain away, have got fixed into the peat itself. On the other hand, black peat has been formed in bogs where the acids of decaying vegetation have drained away naturally, leaving a rich and fertile soil.

F. CALCAREOUS SOILS

Such soils have over 20 per cent of lime in them. They may be either loamy, sandy, or more or less stiff clay. The fertility of these soils depends upon the amount of sand, loam, or clay they contain. The colour of soils has some effect on the crops grown on them. A dark soil absorbs the heat, while a light soil radiates it. When a light soil is once heated it retains its heat longer than a dark soil. The colour of soils also has a different effect on the amount of ammonia they can absorb from the atmosphere. This, however, is beyond the scope of the present book.

THE CULTIVATION OF SOILS

Stiff clay soils should be trenched in autumn, if the depth of soil will allow it to be done, and left in a rough condition, so that as large a surface as possible may be exposed to the action of the frost, &c. The water becomes
The Soil

converted into ice, expands, and so forces the particles apart. In spring the clods can then be easily broken down into a fine tilth.

Where the clay soil is not deep enough for trenching, the subsoil should never be brought to the surface. Rough manure, decaying vegetable refuse, and leaf mould may be dug into the bottom when the first spit is taken off. In the course of a year or two the second spit may be brought up, and the third one may then be treated like the second, and soon you get a layer of good soil from 3 to 4 ft. deep. When this is done, trenching every third year will be found very beneficial. When you commence digging or trenching, an opening two spits broad and one deep should be made where you propose to start digging. Take this loose material to the end of the piece it is proposed to dig, where it will fill in the last spit, thus making the whole level. If on a slope, always commence operations at the top.

Special attention should be paid to the handling of the spade or fork, so as not unduly to tire oneself, and yet for the work to be effectively done. The spade should be put down quite vertically, and the position of the body should be such that its whole weight is on the spade when the latter is being pushed into the ground with the foot. Both hands should be at the top of the spade, until the top of the blade is level with the surface of the ground. Then the left hand should be lowered, grasping the lower part of the handle from the front, and turning over the soil so as to bring that which is at the bottom right to the top, and to bury any weeds to a depth from which it will be impossible for them to come up.
In trenching clay soil, ridging may be done. Standing sideways, put one spit on one side, and one on the other, without breaking in any way. This leaves a deep furrow between the ridges, and exposes a greater area to frost, &c.

Sandy soils should not be dug till spring. If dug early it increases its porosity, and any soluble plant food left in the soil is washed out by the winter rains.

THE LIVING SOIL

During recent years it has been discovered that the soil is inhabited by countless numbers of minute organisms called bacteria. Bacteria are simply one-celled organisms, and measure one micromillimeter in length. A micromillimeter is $\frac{1}{1000}$ mm., or about $\frac{1}{25000}$ in. They are of various shapes: round, called coccus; cylindrical, called bacillus; and spiral, called spirillum.

These lowly organisms do a vast amount of work in the soil. They attack the manure which is placed there, and convert it into liquid plant food. Without such organisms in the soil our fields and gardens would become quite barren. It is therefore necessary for us to see that these bacteria are enabled to work freely, and to multiply rapidly. Some are provided with hairs or flagella. By the lashing movements of these they are able to travel about in the moisture between the particles of soil, and so are enabled to do more work. The majority of these minute organisms require oxygen for their successful development. This shows how important it is that the soil should be thoroughly aerated. They also like a slightly alkaline medium. If the soil becomes too acid by over manuring,
they cease to develop or to do their work. This can be remedied by an application of lime, in the proportion of 15 to 20 lb. of quicklime to a pole of ground, or three times that quantity if chalk is used instead of lime. These substances are alkaline, and neutralize the acidity of the soil.

The time of greatest activity of these organisms in the soil is in spring and early summer, and then again in autumn. During these periods the soil is sufficiently warm, and there is enough moisture to allow them to move about freely. This, of course, coincides with the time of the greatest growth of plants, showing how wisely nature regulates everything for mutual advantage.

The soil, however, is also tenanted by a greater or less proportion of bacteria which may cause diseases such as lockjaw (Bacillus tetanus), &c., and every care should be taken of wounds received when working in the soil. If wounds are already on the hands, no soil whatever should be allowed to get into the wounds. As a general rule, healthy persons can withstand even severe cuts when working in the soil, but this should not cause us to relax our watchfulness with regard to cleanliness in working.

It is difficult for one to realize such infinitely small objects as these bacteria in the soil. A microscope of a high power should therefore be used. A little of the soil to be examined should be mixed with sterilized water. The smallest quantity of this water should then be put on a glass slide, covering it with a cover-slip. Great care must be taken to ensure that slide and cover-slip are perfectly clean. When the slide is placed under the microscope, large numbers of bacteria will be seen moving
about, more or less rapidly. The flagella, by which they are enabled to move, will not, however, be seen, as they are so minute. They can, however, be observed when the organisms are killed and stained. The flagella then show up in lighter tints than the bodies.

CHAPTER II

Manures and Manuring

Manures may be divided into two great classes: Natural manures, and artificial or chemical manures. In the first we include farmyard manures, that made in the stable, the cow shed, the pig sty, the poultry house, &c., all put into one heap and allowed to mature together. It is better, however, to keep them separate, as there are great differences in the nature of the various animal manures, some being richer than others and more suitable for the gross-feeding plants. Some are cool, and hold the moisture better; some are hot, tending to heat some soils and make them more porous. Therefore it is advisable to keep manures apart.

Horse manure is hot and short, and should be applied to cold, stiff soils. Owing to the small quantity of this manure that can be dug into the ground, the temperature is not raised very appreciably, but, being short, it breaks up the soil and makes it more porous, thus allowing the water to drain away and the warm air to get in. The effect of this is to warm the whole soil. It should be applied to such soils in a partially decayed state during
winter, when ridging is being done. In these cold, stiff soils fermentation goes on very slowly during the winter months, therefore there is little fear of much plant food being washed away. Horse manure is often mixed with a considerable amount of straw or peat. It is not so rich in plant food as some of the other animal manures.

Cow manure is cold and moist, and should be applied to light, sandy, or gravelly soils. It tends to bind the larger particles of such soils together, keeps it cooler in summer, and helps it to hold the moisture better for the use of the crops during times of drought. It is richer in plant food than horse manure, and should be applied to light soils in early spring in a well-decomposed state. If applied to such soils in autumn or winter a considerable portion of the plant food would be washed out, or sink down into the subsoil beyond the reach of the plant roots.

Pig manure also is cold and moist, after the nature of cow manure, and may be used in the same way. It is, however, very rich, and should be used sparingly; otherwise some damage may be done to the crops through an overdose. If the pig sties have been thoroughly bedded with straw, leaves, or fresh weeds—which have no ripened seeds on them—there is less fear of damage being done by a fair application of this manure for vigorous-growing crops.

Poultry manure is a very rich manure, and should be used with considerable caution. It is not produced in very large quantities, and is most economically used when put into a barrel that has been previously sunk into the ground. One bushel of manure should be used to a barrel of water. Stir the contents, and allow to settle before using. Some-
times for young plants this mixture should be well diluted. When the barrel is empty of water it can be refilled and used at full strength. The sediment may be put on one side and dug into the soil. In a liquid form poultry manure may be used for any vigorous crop, or for pot plants, with great advantage.

*Mixed farmyard manures*, which have all the qualities combined, may be used for ordinary garden soils which are neither too light nor too stiff.

The application of manures must be regulated (*a*) by the condition of the soil, whether it has been previously well manured or not; (*b*) by the quality of the manure itself; and (*c*) by the nature of the crops which are to be grown on the ground.

Those desirous of becoming successful horticulturists must exercise great care in the application of manures, as the amount necessary for one garden may be an overdose for another.

Generally speaking, from 10 to 15 tons of manure per acre is considered a light dressing, 15 to 20 tons per acre a medium dressing, while from 20 to 30 tons per acre is considered heavy manuring.

Or $1 \frac{1}{4}$ to $1 \frac{1}{2}$ cwt. per pole = light dressing.

$1 \frac{1}{2}$ " $2 \frac{1}{2}$ " " = medium "

$2 \frac{1}{2}$ " $3 \frac{3}{4}$ " " = heavy "

These amounts will have to be modified if artificial manures are used in conjunction with those from the farmyard. If by any chance a garden becomes overcharged with manure, if it has the appearance of a dark fertile soil, yet will not produce satisfactory crops, it may be what is
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Manures are termed "manure sick". This state may be remedied by the application of 14 lb. of quicklime per pole.

When manures are decomposing, acids are formed, and the lime, being alkaline in nature, neutralizes the acidity, and allows the bacteria to do their work of changing the manure into liquid plant food. After being cured of manure sickness, no further manuring may be necessary for one or two seasons.

A few words about the care of manure, previous to its being applied to the garden, may be useful. In most cases no care whatever is taken of it. The main object seems to be to get stables, cow sheds, &c., cleaned out, the refuse taken to some convenient place, and there deposited, to remain until it is required for the garden or field. This involves a very great waste. If farmers and gardeners understood the science underlying the practice of manuring they would retain a valuable amount of plant food in their manures. Almost as soon as the manure is put into a heap, changes begin to take place in it, owing to the activity of bacteria. The substance of the manure is gradually changed into soluble or liquid plant foods. Now, if the manure heap is exposed to the action of the elements, this food will be immediately washed out of it, and a considerable loss thereby sustained. Where it is not possible to have these manure heaps covered, we might prevent part of the loss, at any rate, by stacking the manure properly and treading it down, so that the air may not have free access to all parts of it. This prevents the bacteria from multiplying or working too rapidly, hence less change will take place, and a less amount of valuable plant food will be wasted.
But the washing out of soluble plant food is not the only loss sustained by a carelessly attended and exposed manure heap. There is a class of bacteria which does not change the manure into liquid plant food, but into a gas called "ammonia". Now this, when changed into a nitrate, is one of the most valuable plant foods contained in farmyard manure, and its loss should be prevented as much as possible. This can be done by building the manure into a compact mass, thus preventing the multiplication and work of this class of bacteria also. For these reasons it is better to keep manure in one heap—that is, if it is obtained before being required for use—rather than in many small heaps on the garden. It should be spread on the ground only when required for digging in.

It is, of course, with farmyard manures that one has principally to deal. It is, however, advisable to have some practical acquaintance with some of the chief artificial manures.

When manuring with artificial manures you supply food for the crops alone. They have no effect on the soil, and, as a rule, only sufficient is supplied for the present need of the crops. Whereas, with farmyard manure we not only supply the crops with food, but make a change in the physical condition of the soil; that is, we make it denser, or able to contain more moisture, in the case of light and porous soils, or more porous, in the case of heavy clay soils. We also expect to get the benefit of a heavy manuring with farmyard manure, for two or three crops. Artificial manures are in a highly concentrated form, and must therefore be used with great care by beginners. When the principles of arti-
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ficial manuring are understood, experiments should be made.

There are a great many substances necessary as food for plants. The chief are: Carbon, oxygen, hydrogen, nitrogen, phosphorus, sulphur, potassium, calcium, magnesium, iron, sodium, manganese, silicon, and chlorine.

Of these, nitrogen, phosphorus, and potassium are the three principal substances with which we have to deal in manuring our plants.

Carbon is obtained from the carbon dioxide \((\text{CO}_2)\) of the atmosphere. Oxygen is obtained partly from the atmosphere and partly from water. Hydrogen and oxygen are taken up in the water, &c. The other substances are generally present in all soils in quantities large enough for the use of most plants. But plants never take up their food in the form of an element. It is always as a compound. Nitrogen is taken up in the form of nitrates, phosphorus in the form of phosphates, and potassium in the form of potash.

For example: Nitrate of soda \((\text{NaNO}_3)\) is sodium \((\text{Na})\), nitrogen \((\text{N})\), and oxygen \((\text{O}_3)\); that is to say, 1 part of Na, 1 part of N, and 3 parts of O. Sulphate of potash \((\text{K}_2\text{SO}_4)\) consists of potassium \((\text{K})\) 2 parts, sulphur \((\text{S})\) 1 part, and oxygen \((\text{O})\) 4 parts; and superphosphates \((\text{Ca}_3\text{P}_2\text{O}_8)\) consist of calcium \((\text{Ca})\) 3 parts, phosphorus \((\text{P})\) 2 parts, and oxygen \((\text{O})\) 8 parts. Thus we see that the plant takes up many elements in combination. These are broken up within the plant for its individual use.

We will now turn our attention to the three principal classes of manures, and see how they benefit the crops.
NITRATES

This class of manure can be applied in many forms, but the two principal forms are nitrate of soda and sulphate of ammonia. Although supplying the same food substance to plants, they should be used in different ways, on different soils, and for different reasons. Why is this? Nitrate of soda is in such a form as that, when simply dissolved in water, it is at once available as plant food, whereas sulphate of ammonia has to be changed slowly into a nitrate before it is available to the plant as food. We know that flour contains the elements of food necessary for man, but we do not make a meal of it in the form of flour. It is first made into bread, and then it is in a suitable condition for our use. So it is with sulphate of ammonia. The little bacteria in the soil take hold of it, and change it into a nitrate. Now, what does this teach us about the application of these two important manures? In a wet season you must not use the more soluble nitrate of soda. A little rain would dissolve it, but a large quantity of rain would not only dissolve it, but would wash it through the soil into the subsoil, beyond the reach of plants, or perhaps into the drains, where it would be entirely lost. In such seasons it is better to use sulphate of ammonia, which has to be changed into nitrates before it can be utilized by the plants as food. As this process goes on slowly, the plants are able to make use of the nitrates as food before they are washed out of the soil.

On heavy (clay) soils, there is less fear of the nitrates being washed out. Even if the sulphate of ammonia does dissolve, the soil being saturated with moisture, the super-
fluorous water simply runs off the surface, or percolates very slowly through it, allowing the plant time to take up the nitrate.

On light (sandy) soils where there is a sufficient or rather heavy rainfall it is better to use sulphate of ammonia. On sandy soils, however, where there is a deficiency of rain it is better to use nitrate of soda, or easily soluble nitrate manure. From what we have already learned about these two manures it will be seen that there must be a difference in the time of application. Nitrate of soda, when dissolved, is available to the plant as food, and must be applied when required by the vigorous-growing plants. On the other hand, sulphate of ammonia, which has to be dissolved and changed into a nitrate before it can be used by the plant as food, should be applied from three to six weeks—according to the season—before it is required in greatest quantity by the plants. About 1 cwt. per acre of these fertilizers is the amount necessary, or about 1 lb. to 40 sq. yd., and should be given three or four times during the vigorous-growing season. Care must be taken to prevent it getting on to the leaves of plants, or it will burn them.

Many are familiar with the fine, green, healthy-looking appearance of crops after one application of nitrogenous manure. We therefore know that nitrates induce a strong, healthy growth, and this also gives us an idea of the kind of crops to which we should apply these manures. They should be crops which we wish to grow luxuriantly, such as Cabbages, Kales, Celery, Asparagus, &c. Other nitrogenous manures are nitrate of potash, which is too expensive and too dangerous for use except by experts; and guanos,
which supply a greater or less amount of nitrates for the plants.

PHOSPHATES

There are many forms of this class of manure. Superphosphate, however, is one of the principal, and is formed by treating certain mineral phosphates with sulphuric acid, thus making the phosphates more soluble and more readily available for plant food. We must, however, be careful in the application of such acid manures, as we have previously seen what happens when the soil becomes acid in reaction. We must see, therefore, that we have sufficient lime in the soil to neutralize the acids. Lime also combines with the superphosphates, and prevents them from being dissolved and washed out of the soil before they can be utilized by the plant as food, the plant afterwards taking up the phosphate slowly from the lime. Superphosphate is naturally a quick-acting manure, that is, it is easily dissolved and made into food available for the plants.

Then we have the various forms of bone manure, which contain a large proportion of phosphate. They are, however, very slow in action, and should be applied where slow but sustained action is required, such as when young fruit trees are planted, when lawns are being formed, &c. Then there are crushed-bone manures, bone meal, and steamed bone flour. The fineness of these various manures will be a guide to the method of their application.

We have also basic slag, which is a slow-acting phosphatic manure, and which contains a large proportion of lime. Now, for a heavily manured garden ground, this
Manures and Manuring

is a profitable form of phosphatic manure to use, as it not only supplies the crops with phosphates, but also supplies lime to the soil, and we have already pointed out the value of lime to a heavily manured ground. Now, from what we know about these phosphatic manures, we can form an idea of the method of their application. We know that superphosphate is quick-acting, therefore it should be applied about the time it is required for the use of the plant as food. That is, it should, as a rule, be applied in spring, and at the rate of from 3 to 5 lb. per pole.

The various bone manures should be used at the rate of from 5 to 10 lb. per pole.

Basic slag, being slow in action, should be applied in winter, at the rate of from 5 to 10 lb. per pole. Nearly all crops benefit by the application of phosphates, more especially fruit crops. Their action is not so apparent as that of nitrates, but is quite as beneficial.

POTASH

This is a most valuable manure, but its use must be thoroughly understood before being applied, as considerable damage may be done if it is used improperly. Many soils contain sufficient potash for the use of the crops, but it is often found in such a form as not to be available for use as food. Again, there are certain crops which take a greater amount of potash out of the soil than others. It is then necessary to supply it in such a form as can most readily be used. Potatoes, Beet, and Carrots require a great amount of potash. Fruit also requires a consider-
able quantity. Potash improves the quality of all crops if properly applied, and also intensifies the perfume of scented flowers. Heavy clay soils usually contain sufficient potash for the need of most plants. Its application is therefore more particularly required on light, sandy soils, and there is no fear of its being washed out, especially if there is a sufficient quantity of lime in the soil. The lime neutralizes the acid, and unites with the potash to form carbonate of potash. Sulphate of potash is the best of the more concentrated forms to use, as it is not easily washed out of the soil. It is better to apply this particular manure early, even in winter, when it is purified in the soil, and by the springtime or early summer it is in a state available as plant food.

**MURIATE OF POTASH**

This is another concentrated form of manure, but, as it should only be used by the most experienced gardeners, it is not necessary to deal with it here to any great extent. It must be applied very early in the winter, so that it can be thoroughly purified in the soil before the crops grow up. Some crops, such as Potatoes, prefer this form of potash on certain soils, but there is a great danger of doing injury when its proper use is not well understood.

**KAINIT**

This is another form of potassic manure. It is less concentrated, and therefore there is less fear of doing any damage by using it. It is, however, less pure, and must be applied early in winter, so that purification may
go on during the time there are no plants in the ground, and also to give time for it to be changed into the available form of plant food. It contains a considerable quantity of common salt as an impurity, so that it is especially suitable for crops which require salt, such as Asparagus. Sulphate or muriate of potash may be applied at the rate of from \(1\) to \(1\frac{1}{2}\) lb. per pole. Kainit may be applied at the rate of from \(8\) to \(10\) lb. per pole.

Wood ashes contain a considerable proportion of potash, and therefore should be saved and spread on the soil to supply that manure. It is also perfectly safe in use, and two or three times as much may be applied with safety as when kainit is used.

**MIXED MANURES**

There are many mixed manures on the market, some very expensive, but useful, and some that are practically of no value. It is therefore worth while to study the problem of manuring. From what has been said we now know the necessary substances required to form the food of plants. It should therefore be a comparatively easy matter to make a selection of the most suitable manures for any particular crop or soil. Soils differ so much that only general guidance can be given in any book. Each individual must make careful experiments, and note very closely the results of each experiment.

There are certain manures which may be mixed quite freely. Others, however, should not be mixed, as they act on each other, and the necessary properties for manuring of one, or perhaps both, may be lost. For example, if basic
slag and sulphate of ammonia are mixed, the lime, which is largely present in the basic slag, will unite with the sulphuric acid of the sulphate of ammonia, forming sulphate of lime, and the ammonia—i.e. the plant food—will be liberated in the form of gas, and thus entirely lost. Again, we have a similar loss if we mix nitrate of soda with superphosphate. The sulphuric acid of the superphosphate will drive out the nitric acid of the nitrate of soda.

Similarly, we should not mix superphosphates with basic slag, as the soluble phosphates will unite with more of the free lime of the basic slag, and will be rendered almost entirely insoluble, therefore useless as far as the plant is concerned. Again, basic slag should never be mixed with guano, or ammonia will be liberated and lost. It is therefore better to use artificial or chemical manures separately. The plants are then more certain of getting the full manurial value.

There are some expensive manures which fully repay the gardener for his outlay. They have the additional advantage of being made up in convenient quantities for the small grower. They can also be obtained in tins which are practically air-tight, and therefore prevent any loss of the valuable qualities.
CENTRE PATH OF GARDEN WITH FRUIT TREES AND FLOWER BORDERS
CHAPTER III

Seeds and Seed Sowing

If we try to understand the seeds themselves it will be a great help to us in our treatment of them at sowing time. Let us, therefore, take a seed and examine it. For our purpose the bean is one of the best, as, from its size, we are able, with the unaided eye, to see all its parts clearly. All dicotyledonous seeds agree with the bean in general principles.

The first point to notice is the black scar (hilum) showing where the bean was attached to its stalk, which in turn was attached to the seed vessel, and the parent plant. If we examine this scar very closely we shall notice at one end a very tiny hole (micropyle) through which the pollen tube passed before fertilization took place. By examining the skin or outer coat (testa), we find it to be thick and leathery, and from this we conclude that it acts as a protection for the more tender tissues which are underneath.

When the skin is taken off, the bean splits naturally into two parts. These are the seed leaves (cotyledons), and are filled with food material to supply the baby plant with nourishment until it has formed roots and green leaves, and can take up and manufacture its own food. Some seeds,
such as wheat, have only one seed leaf, or cotyledon: these are the monocotyledons—the others are dicotyledons.

We thus see that the plant prepares for the future, when it diligently gathers and stores up food, not only for its own use, but for the use of the baby plant or embryo.

When we open the two cotyledons we find a very small part, distinct from the seed leaves, but joined to them by two small stalks, one attached to each seed leaf. On closer examination, either with the naked eye or with a lens, we find that this is a rudimentary or baby plant. We can distinguish the beginnings of the root (radicle), and the stem (plumule), and even the first two leaves of the plant, with veins already plainly marked.

We thus see that the seed consists of three principal parts:—

1. The embryo, or baby plant,
2. The cotyledons, or seed leaves.
3. The testa, or outer skin.

If we understand our seeds thoroughly we shall know exactly how to treat them. When we go to Nature inquiringly she will supply us with the solutions to many seemingly intricate problems. Nature has supplied all seeds with a skin for protection, but it is not always a sufficient protection. This is a hint to us that we ought to guard our seeds against injury. If seeds are exposed to frost they die—except, of course, the very hardy weeds, some of which will germinate even at freezing-point. Moisture also injures seeds. If the latter are stored in a damp place, they absorb the moisture in the atmosphere, the skin will then swell, and, being porous, it passes on the
Seeds and Seed Sowing

moisture to the seed leaves. There a chemical change sets in. The dry, stored food is changed into liquid plant food. The temperature rises with this change, and our seeds become what is termed heated, and therefore perish.

When seeds are sown, the skin allows only a limited supply of moisture to get through at a time. Thus the change—food substance to food—goes on slowly, as required by the baby plant. The skin also helps to protect this embryo in its earliest stages from attacks by disease germs in the soil. In the bean there is a considerable amount of food stored up, but in smaller seeds there is naturally a much less quantity. For example, the Shirley Poppy seed contains a very small amount of food substance. Now this ought to tell us about what depth to sow our seeds, because by the time all the food stored up is exhausted, the plant should be above the soil. Its roots will be penetrating into the ground and will be absorbing food substances from it. These substances, however, are in a raw state, and must be manufactured into the proper food for the plant, in the green leaves, under the action of sunlight.

If the plants, therefore, have not reached the surface of the soil, and spread out their leaves to the sun before all the food is used up from the seed, the plant will die of starvation. Therefore, beans should be planted from $2\frac{1}{2}$ to 3 in. deep, and the smaller seeds at decreasing distances, until we come to the very smallest seeds, such as those of the Calceolaria, which should be sown on the surface, and lightly pressed into the soil.

We will now turn our attention to the baby plant itself. It is a living thing, and all living things require air.
Therefore, when seeds are sown, the soil should be in a proper condition to receive them, so as to ensure a free supply of air. Every living thing requires water, therefore seeds require water, but at first only a limited quantity, as it is only wanted to soften the skin and set in motion the substances which change into food for the young plant. If too great a supply is given, the air is excluded and suffocation takes place. Then, again, the seeds of all cultivated plants require a certain amount of warmth. For the ordinary outdoor garden crops there is usually sufficient heat in the ground itself in spring, early summer, or autumn to ensure germination.

We now see that there are three necessary conditions for the germination of our seeds, viz. warmth, air, and moisture, and that should be an excellent guide to us as to when and how to sow our seeds. We must sow them when there is sufficient heat in the soil to allow them to germinate and to keep them growing. The hardier ones, such as peas, beans, and parsnips, may be sown in February or March, while the less hardy ones, such as onions, turnips, cabbages, savoys, &c., should not be sown until March. The tender seeds, such as carrots, beet, cauliflowers, and most annual flowers, should be left until April. There is then sufficient heat in the atmosphere to keep the plants growing when they have come up. About this time, also, the superfluous water from the winter rains has either drained away or been evaporated from the soil. The spaces between the particles of soil are then partly filled with moisture, and partly with air, thus ensuring a plentiful supply of air as well as a sufficiency of moisture for the needs of the germinating seeds. When about to sow seeds
the ground should first be carefully measured out, and lines set across the garden to keep the drills perfectly straight. Then the feet should be placed on the line, care being taken to put the feet down so as not to move the line either to the one side or the other. Then the line will be perfectly tight, and will resist the pressure from the side when the drill is drawn with the hoe. Keep the feet firmly on the line as the hoe is drawn back. Hold the hoe well up, and cut the soil, thus throwing the latter out on either side, rather than drawing it into a heap at the end of the row. Care should be taken to keep the bottom of the drill level, so as to ensure regular germination. When the seed is sown it should be gently pressed with the feet to make the soil firm, thus preventing the loosened soil from being dried up, and the seed suffering in consequence, especially with the shallow-sown seeds. When sowing peas and beans, which are covered with about 2½ to 3 in. of soil, this does not apply. For peas, the drills should be drawn with the flat of the hoe and the seed sown thinly. The soil should then be drawn over it with the hoe, one-half being drawn in from one side, and the other pushed in from the other, leaving a very slight ridge. Care should be taken that the centre of the ridge is right over the line of seed. This will ensure the plants coming up regularly over the whole of the ridge.

The time during which seeds preserve their vitality varies. Hawthorn and Holly seeds should be sown as soon as they are ripe, but as the Hawthorn takes twelve months and the Holly two years to germinate, they can be sown in boxes of moist sand, and afterwards lifted and sown in the proper place before germination actually takes
place. Melon seed will germinate, if thoroughly matured, after four or five years. Some seeds have been known to preserve their vitality from twelve to sixteen years. This, however, is rare. The stories about wheat germinating after being taken from the hand of Egyptian mummies, where it has probably lain for thousands of years, are entirely without foundation. Dealers are said to have rubbed wheat in yellow mud, placed it in the hands of the mummies, and then sold it to travellers, who have been full of enthusiasm at having obtained —what they thought—such a rarity. It has, however,
been proved that seeds will not preserve their vitality for more than twenty years.

Before leaving this subject I should like to draw attention to the provision Nature has made for the dispersal of seeds. We are all familiar with the white, downy heads of the Dandelion and the Thistle, which enable the seeds to float about in the air; and the winged seeds of the Pine, which are carried a considerable distance from the parent tree. Some seeds have little spears which enable them to stick to animals, while other seed vessels, when matured, burst open, scattering their seeds to a considerable distance in all directions. This dispersal is to prevent the seeds from falling too thickly round the parent plant, and the subsequent overcrowding of the young ones.

CHAPTER IV

The Plant

The plant is made up of two principal parts, the root and the stem, but each of these consists of other parts having certain distinct functions to perform. The root holds the plant in its proper position in the soil. It also collects and conveys the food substances from the soil to the stem, thence to the leaves. It is branched many times. Each time the branches get smaller, until at last we get the very fine ones, or root fibres. Near the growing point of these fibres we find a band of very, very slender root hairs. These are of the greatest importance to the plant, as it is they which collect all the food substances required
by the plant from the soil, and pass them on, through the root fibres and roots, into the stem and leaves. These root hairs are composed of one cell, which is simply a greatly elongated cell of the epidermis of the root fibre. The walls of these little root hairs are porous, and cling very closely to the particles of soil, sucking up the moisture and soluble plant foods which surround them.

If you pull up a young plant carefully, this can easily be seen. The particles of soil will be found clinging to the root hairs, or, rather, the root hairs cling tenaciously to the little soil particles, where the band of root hairs is, while the soil falls entirely away from the older parts of the root, where there are not any root hairs. These tiny hairs not only absorb the moisture and soluble plant food, but they give out a weak acid solution which is able to dissolve certain substances in the soil. These substances are then absorbed and passed on into the plant. The life of these root hairs is very short, as is seen by the growth of the root, there being no root hairs beyond 3 or 4 in. from the apex of the root. They have an enormous amount of work to perform, and must therefore always be in the very best condition to carry on that work. As the old ones die off, new ones are formed nearest the apex, and so the work goes on constantly and vigorously.

We can trace the course of roots on the inside of a new flower pot, or if we allow the roots to grow through the flower pot on to a piece of white marble, and then, after a considerable time, raise the plant, we find there are
brown marks on the marble where the roots have been lying. We may even wash it, but the marks remain. Therefore we know it is not only soil, but is in reality a change which has taken place in the marble itself, brought about by the action of weak acid which was given out by the root hairs. This acid has dissolved the carbonate of lime contained in the marble, and some has been absorbed by the plant as its food.

Now, roots are living things, and require air as well as moisture. Therefore we must keep our soil in a sufficiently open condition to prevent the water from accumulating, and thus keeping out the air that should have access to the roots. If such a state arises it must be remedied at once. We must, of course, always have sufficient moisture in the soil, as this not only dissolves the food substances, but also acts as their carrier right through the plant to the leaves, and even back again from the leaves to the growing points of roots, shoots, leaves, fruit, &c. If there should be a scarcity of moisture at any time, the little tubes of which the roots and stems are composed get filled with air, then no more moisture with food substances can pass along them, and the plant will die. Therefore, though we should never have an excess of moisture, yet we must on no account allow our plants to get too dry. Sometimes, when the soil appears to be dry, there may be sufficient moisture in it for the needs of the plant. A little experience, with careful observation, will soon enable us to understand when plants require our aid in providing them with moisture.

Let us now examine the stem, and we shall at once see that it consists of many parts. First, there is the main
stem; then, in many instances, there are the branches, which become finer and finer until we reach the tiny twigs. Then we have the leaves, and it is here that all stems differ from roots. Some stems are almost exactly like roots, such as the suckers of roses, while some roots are like stems, such as those of trees which are growing on a bank where the soil has fallen away from them, leaving them exposed to the atmosphere. They then become quite like stems. But no true root ever bears anything but branch roots, whereas stems bear leaves, which are quite different in appearance and structure from the stem itself.

The stem, like the root, is composed of little tubes, which conduct the moisture and food substances through one section to the leaves, and, after they have been manufactured there, pass them through another section back to the various points of growth. Stems, like roots, are covered with a skin or epidermis. In the stems of annual plants this skin is thin and transparent, but in other stems layer after layer is added to it, until we get a bark consisting of many layers, which, in the case of the Scots Pine, breaks up into many scale-like parts, or, as in the Beech, Apple, Cherry, &c., remains in a thick layer. Stems have special breathing pores, so that they can have an interchange of fresh air. In annual stems we may have stomata (pores) in the thin skins, but in the thick bark these are impossible. In their place are lenticles. These can be plainly seen as little excrescences on the bark of the Elder. They are, in reality, little holes filled with a host of tiny oval cork cells, exactly like sand in a filter, and through these the stem breathes.

All stems are made up of layer upon layer. First we
get the bark of varying thickness; then we get the phloem, or bast—soft woody tissue—after which comes the cambium, or actively dividing tissue. This is the layer from which all the others spring and add to their growth. Inside this layer we have the xylem, or wood proper, and the centre is made up of thin-walled cells—the pith.

In some stems, such as that of the Elder, the pith forms a considerable part of the young stem; but in others, such as that of the Beech, it is very small indeed. We already know that the stem or branches bear leaves. These leaves are of the greatest importance to the plant. They are usually flat in shape and green in colour. There are exceptions, however, as the shape of the Onion leaf is round, and the colour of the Purple Beech leaf slightly brown. Leaves are covered with a skin or epidermis. This skin is perforated by large numbers of microscopic
pores (stomata), which are surrounded by tiny cells called guard cells. It is through these stomata that the plant breathes most actively. These stomata also take in a large proportion of food substance from the air in the shape of a gas called carbon dioxide (CO₂). They also give off the superfluous moisture which has been taken up by the roots. The guard cells of each stoma are affected by the light. In intense sunlight they open widely, but as darkness comes on they partially close. The atmosphere, when saturated with moisture, also has the effect of partially closing them. The stomata are more abundant on the underside of the leaves. Here again Nature has taken precautions for the welfare of the plant, as in this position there is less fear of these stomata being choked with dust than if they had been on the upper side of the leaf.

Underneath the epidermis we get the layers of cells which are filled with coloured matter called chlorophyll. This substance is usually of a green colour, although it varies, as can be seen from that of the Beetroot, Copper Beech, &c. Now it is in these layers, in the chlorophyll corpuscles of these layers, under the action of sunlight, that all the food of the plant is manufactured. The parts which are taken up from the soil by the roots unite with
that taken in from the atmosphere, and in the coloured cells of the leaves the great changes are made.

We will again review those substances taken in by the plant from the soil and from the air, and try to trace them into the substance of the plant itself.

First, the plant takes up from the soil—by means of its root hairs—nitrogen, oxygen, hydrogen, phosphorus, potassium, sulphur, calcium, iron, magnesium, silicon, and chlorine; while from the air—by means of the stomata in the leaves—carbon is taken. These substances unite in the chlorophyll of the leaves under the action of sunlight. Great changes then take place. The brighter the sunshine—as a general rule—the quicker the change goes on, and consequently the quicker the growth of the plant.

The first substance we know to be found is starch. This consists of 6 parts of carbon, 10 of hydrogen, and 5 of oxygen—\( \text{C}_6\text{H}_{10}\text{O}_5 \). Another that is formed later is grape sugar. This also consists of carbon, hydrogen, and oxygen—6 parts of carbon, 12 of hydrogen, and 6 of oxygen (\( \text{C}_6\text{H}_{12}\text{O}_6 \)). Again, we have cane sugar (\( \text{C}_{12}\text{H}_{22}\text{O}_{11} \)). Then we get cellulose, which is the material of the cell wall, and is \( \text{C}_6\text{H}_{10}\text{O}_5 \). We therefore see that this is of the same formation as starch. The living sub-
stance within the cell consists of carbon, hydrogen, oxygen, nitrogen, and sulphur, and is called protoplasm. This protoplasm is always active in living cells, but if heated to 120° F. it coagulates, like the white of an egg, and dies.

If we examine a young living cell through the high power of a microscope we can distinguish in its substance a little round ball or star-shaped body. This is the nucleus, and is composed of carbon (C), hydrogen (H), oxygen (O), nitrogen (N), sulphur (S), and phosphorus (P). This also contains, in certain instances, even smaller bodies when the division of a cell is about to take place. It is this nucleus which divides first into perfectly equal parts. Then the cell wall forms between the two halves, thus making two cells. Sometimes, however, it is a very complicated process. The nucleus divides, then each of the two halves divide again, thus forming four nuclei, after which four walls begin to form simultaneously, thus giving rise to four new cells at once.

We thus know what substances are required for the building up of the principal parts of a plant, and what is the importance of these different parts in the life of a plant.

But there are many other substances which go to form the food of plants, and are found in different parts of the plant—such as oil in the Castor-oil plant, inulin in the tuberous roots of the Dahlia, while in the Ficus we get cystoliths, that is, grape-like clusters of calcium carbonate. There are many other substances found in plants, but the reader will have to consult special books for a further study of these, as they are beyond the scope of a work of this kind. It is surprising, however, when we begin our study of plant life, to find that these simple substances are taken
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in by the root hairs from the soil, and also by the stomata of the leaves from the atmosphere, and there, in the chlorophyll-filled cells of the leaves, they unite, under the action of sunlight, to form very important plant substances, and this at the ordinary temperature of the atmosphere; while such changes, when carried out in a laboratory, require

an enormous amount of heat. When we examine the tissue of the leaf we find how Nature has arranged the cells to get the greatest amount of work done for the space taken up, and also how the cells have been arranged to prevent any damage from excessive heat of the sun. Wherever the heat of the sun comes into direct contact with chlorophyll it kills it, but the cells on the upper side of the leaf are elongated, running from the epidermis into the centre of the leaf, and the chlorophyll corpuscles are

Organs for Removal of Substances
arranged along the sides of the cells. Thus the one acts as a protection to the other.

Then there is usually a second layer of cells of the same kind, but smaller. These two layers of elongated cells are called the palisade layer. Underneath this are two or three layers of large, irregularly shaped cells, with large air spaces between. These are called the spongy parenchyma. If we look again at the leaf, we see at once that it has a perfect network of veins. When we have obtained a perfect knowledge of the other parts of the plant we shall readily understand how necessary these veins are. They are like miniature stems. They have different kinds of tissue, with different vessels or tubes to carry the food substances from the stem and distribute it to the chlorophyll-containing tissue of the leaf, where it unites with the carbon dioxide of the air and is manufactured into plant substances. It is then collected by these veins, and passed along through them into the stem, and thence to the parts where it is required. Many leaves
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have hairs on them. These act as a protection in one way or another. Most of us are well acquainted with the sting ing hairs of the nettle. In some plants these hairs catch the dust, and prevent it from getting into the stomata. Again, some leaves, such as those of the Holly, Laurel, &c., are protected by a very thick skin. Trees which usually grow on very exposed places have needle-like leaves, to prevent them from being destroyed by the wind, e.g. Pines and Firs. Other plants, which flourish on rocky or very poor ground, where they are liable to be dried up, have specially adapted leaves that are curved at the margins, and so retain the moisture, e.g. Heather, Mosses, &c. Again, we have the water plants, with two kinds of leaves, as the Water Ranunculus. Thus, as we advance step by step, we see how Nature has adapted everything to the greatest advantage. There are the leaves which float on the surface of the water, or grow above it; then there are the leaves which grow under the water. The latter are finely divided, like thick threads. The advantage of this will readily be seen. As this plant often grows in streams, the current would tear the broad, flat leaves, and so prevent the work of food manufacture going on satisfactorily; but
with the divided leaves the current flows through them without doing any harm.

There is a curious phenomenon connected with the fall of leaves which is not very well understood, viz. Why, in the case of deciduous trees, the leaves become detached in autumn, and in the spring in the case of evergreen trees and shrubs, while, if a branch breaks off during the growing season, the leaves die, but do not drop off? The reason is this: at the point of attachment to the branch of the leaf, or leaf stalk, a layer of cork cells is formed during the growing season; very slowly at first, but as the season nears its end the whole plant begins to mature, and this layer of cork cells spreads through the whole of the tissue of the leaf stalk. These cork cells are now quite dead, and as the layer advances through the tissue it gradually cuts off all communication between leaf and stem, until it forms right through, and then the leaf drops off. When, however, the branch is broken off, this layer is not formed, and a close connection is maintained between stem and leaf, thus preventing the leaf from falling off, even though it be dead.

INFLORESCENCE

This is simply a collection of flowers, which may be formed in a raceme, as in the Wallflower, with the flowers surrounding the greater part of the apex of the stem; or it may form a capitulum, as in the common Daisy. Here the ray flowers, which are very small, have petals tinged with
pink, and the disk flowers, which are also very small and tubular, and yellow in colour, form the yellow centre of the inflorescence. There are many other forms of inflorescence, with which we have not space to deal.

**THE FLOWER**

A perfect flower, such as the Buttercup, is made up of four parts:
1. The calyx—which is divided into five sepals—and is green and leaf-like in appearance. This forms the under part of what is called the flower. 2. The corolla. This is divided into five petals, which are brightly coloured, and quite different in appearance from the sepals. 3. The androecium, which consists of a great number of stamens. Each of these stamens is very slender, and has at its apex a little yellow body called the anther. 4. The gynaeceum, which consists of a number of carpels. Each carpel consists of an ovary, or seed vessel; a style, or very short stalk; and a stigma.

What are the uses of these parts?
First, we naturally turn to the sepals. The use of these is to protect the bud and the more tender parts of the flower. Secondly, the petals, being larger and brightly coloured, are for attraction. They attract insects to the flower. These insects,
wandering from flower to flower, carry the pollen on their head, body, or legs. Some of this pollen is rubbed off on the stigma of another flower, and pollinates it. Thirdly, the stamens, or anthers at their apex. Here are the pollen grains. These are formed inside the anther by a process of cell division, and, when matured, are more or less little round cells perfectly free. The anther bursts at a certain place, and this pollen lies in a mass awaiting the visits of bees, &c., which carry it away to

feed their young. In going from flower to flower in search of nectar with which to make their honey, and pollen for their young, bees leave some of the latter behind on the stigmas of the flowers. If the stigma is matured, the little pollen grains germinate, like a flower seed, and send a little pollen tube down through the tissue of the stigma and style to the ovary, and hence to the ovules. The nucleus of the pollen grain unites with the nucleus of the ovule, which grows rapidly, and forms the seed. Fourthly, the gynæceum, or ovary, at the base, which produces the tiny ovules. These spring from the placenta, or certain parts of the walls of the ovary, and are covered with a double skin, which has a small opening at one end, the micropyle, through which the pollen tube enters.
Inside, at each end, are a few cells and a nucleus. This unites with the nucleus of the pollen tube, after which, the united nuclei divide, and then divide again very rapidly, filling up the ovule with tissue. The embryo is also formed within the ovule, which therefore becomes a seed. The tissue is gradually stored with food substances, and the whole seed gradually matures. The ovary, which has enlarged rapidly, to suit the requirements of the growing seed, is now known as the seed vessel, which, when mature, splits open, liberating the fully developed seeds.
Thus it is seen that the androecium and the gynaeceum—the stamens and carpels—are the principal parts of the flower, and that the petals are chiefly used to attract insects, a most necessary thing to effect pollination and afterwards fertilization; while the use of the sepals is to protect the other parts of the flower from injury, especially in the early stages of development.

There are other kinds of plants, such as the Melon, which have flowers with stamens only, and flowers with carpels only, both on the same plant. The plants in such cases are said to be monoecious. There are other plants, such as the Aucuba, with unisexual flowers, where the flowers with stamens are on one plant, while those with carpels are on a different one. Such plants are said to be dioecious. There are flowers also, like the Guelder Rose, which have neither stamens nor carpels, and are therefore called neuter.

FRUITS

The flower as a whole is a modified shoot, the parts being altered to suit the functions which they have to perform. We know this from the frequent change of the stamens into petals, in the double, or semi-double flowers, and the occasional change of carpels into petals, or even into deformed foliage leaves, in the Begonia. The fruit is simply the developed carpel or carpels. After fertilization
has taken place, great changes go on in the rudimentary fruit. In some cases the walls remain thin and leathery, as in the seed vessels of the Iris. In others a great development of the walls of the ovary takes place, as in the Cherry, Plum, &c., when we get what is commonly known as the fruit. If we examine a plum, we find it is made up of three distinct parts: the epicarp, or skin; the mesocarp, or fleshy part; and the endocarp, or stone. Such fruits are known as drupes.

Other kinds of fruits, such as the Gooseberry, Currant, &c., have the mesocarp filling the inside, with the tiny
seeds floating in it. Such fruits are called berries. Other fruits, such as the Raspberry and Blackberry, are really collections of tiny fruits, and are called collective fruits. Others, however, popularly called fruits, are not really fruits in the true sense of the word. Such are the Fig, Strawberry, Pineapple, Mulberry, &c. The Strawberry is a greatly enlarged receptacle which becomes succulent, bearing the true fruits as little seed-like bodies on the outside. The Fig is also an enlarged receptacle which becomes succulent, but it is hollow, and bears the true fruits as seed-like bodies in the inside. The Pineapple and Mulberry are simply the perianth leaves which become fleshy, forming what is commonly called the fruit. All such fruits are known as pseudocarps or false fruits.

So far we have been studying plant life generally. There are many kinds of plants. They can, however, be roughly divided into three classes: (1) Annuals; (2) biennials; and (3) perennials.
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ANNUALS

The very name suggests what they are—yearly plants. That is, the seeds are sown, the plants attain their full growth, flower, produce seeds, and then die down all in the one season; hence their name. There are a great many plants of this description in our gardens, such as Candytuft, Mignonette, &c., among the flowers, and Peas, Beans, &c., among the vegetables.

BIENNIALS

Again the name suggests the kind of plant—two-year plants. That is, the seed is sown one season, the seeds germinate, and the plants make considerable growth, but it is not until the second season that they complete their growth, and produce seeds, after which they die down entirely. Such plants are: Canterbury Bells, Foxgloves, &c., among flowers; and Carrots, Turnips, Onions, Leeks, &c., among the vegetable plants.

PERENNIALS

Perennial plants are those that live more than two years. This is a very large class of plants, and must be divided into two divisions: (a) Herbaceous perennials. Such plants have herbaceous roots and annual stems. When the seed of such plants is sown, it grows up and produces flowers the same year, after which the stems die down, but the roots remain alive in the soil during the winter, and, from buds on its crown, produce stems the following season, which in turn produce flowers and seed,
dying down again at the end of the season. This goes on year after year, so long as the plant is kept in a healthy state. Such plants are: Phlox, Michaelmas Daisy, Herbaceous Pæony, &c.

(b) Woody perennials. Such plants continue to grow year after year, both root and stem, as long as they remain in a healthy condition. For convenience they are divided into two sections: 1. Those producing a main stem, which takes the lead, and keeps it more or less throughout life. These, known as trees, are familiar to everyone, and they sometimes live to a very great age, as in the case of the Oak and the Yew. 2. Those which do not produce a main stem, or, if they do, the side shoots or branches grow out strongly, and overtake it, forming what is known as a shrub. Examples of these are seen in the Aucuba, Laurels, Rhododendrons, &c.

PLANTS SPECIALLY ADAPTED FOR VARIOUS FUNCTIONS AND MODES OF LIFE

First amongst these might be mentioned the lovely Orchids, which in their natural habitat grow curiously on the branches and trunks of forest trees, &c. Their roots cling to the stems of the trees. When the leaves fall from the tree, many are caught amongst the roots of the Orchid. Here they decay. The roots of the Orchid spread amongst this substance, absorbing the plant food from it, while large masses of aerial roots are formed, which absorb the moisture from the humid atmosphere in which they grow. Such plants are called Epiphytes.

The Mistletoe is another plant with a peculiar habit. It grows on the stems of certain trees—Apple, &c., but,
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unlike the Orchid, has no true roots. When a berry or seed is deposited on the bark of a suitable host plant, and the conditions are favourable, it will germinate, producing cellular processes which are able to make their way into the tissue of their host plant, absorbing the tissue on their way, until they reach the layer which is conveying the food material from the root to the leaves of the host plant. They then appropriate this food material for their own use, pass it on, through the processes mentioned before,
into the branches and leaves, which in the meantime have been formed. There it is manufactured into food substances for its own nutrition and growth. Unless grown in large quantities on a tree it does very little damage to the host plant, as it only takes the food material from a small part of the tree, while the rest of the layer all round is sending up the full quantity. Such plants are known as partial parasites; partial, because, though living on another tree, and taking some of the nourishment from it, yet they have green leaves which absorb the carbon dioxide from the atmosphere, and so manufacture their own food for the leaves. These partial parasites can be introduced into a tree by procuring ripe berries, which are placed into a slit made in the bark of the tree.

The Cuscuta or Dodder is another peculiar plant. Its seeds germinate in the ground, sending up a filamentous stem which twines itself round certain plants, and at various points sends out sucker-like processes which penetrate the tissues of its host plant, making their way right into the wood fibres and drawing from them the food which has been manufactured in the green leaves of the
host plant, and which is being sent by it to the points of growth. There are other little branches of these sucker processes, which only go to the bast fibres, and these take up the moisture which is being sent up from the root by the host plant. The base of the Cuscuta plant soon dies away, and as it produces no foliage leaves it depends entirely on its host plant for all requirements. Such plants are known as parasites. It produces small complete flowers, with calyx, corolla, androecium, and gynaeceum, and also ripens seed, which falls into the soil, and which, under favourable circumstances, germinates and produces new plants.

Drosera, or Sundew, is another very peculiar plant, found in abundance in some marshy places. It is easily detected by its peculiar little round leaves, closely covered with stout, reddish hairs, which have a little ball at the apex. These little hairs are very sensitive to the touch of any nitrogenous substance. Should a fly or other insect come into contact with these hairs they immediately close over it and kill it. The hairs then excrete a substance which practically digests the insect; after which it is absorbed by the plant as part of its nutrition. A curious fact about these plants is, that if a very small stone or piece of cinder is placed on the hairs, it has no effect whatever on them. These plants are known as insectivorous plants. They also produce flowers and
seeds, which, under favourable conditions, germinate and produce young plants in spring.

If the reader has thought carefully about his garden and plants during the perusal of these pages he will at once see how important it is to understand thoroughly all about his plants. He will then be able to put his knowledge to the best possible use, and the most menial operations will become intensely interesting. Even weeding may become pleasant when we think of it as giving the plants plenty of air and allowing the maximum amount of sunlight to get to the leaves of the plants, so that they can be fully employed in manufacturing food, and at the same time getting rid of the weeds, so that the plants proper may have a greater amount of food substances.

Again, the washing of flower pots should be interesting when we remember that we are opening the pores of the pot so that air can penetrate to the roots of the plants, and so on.

Should our seeds fail to grow, we must not immediately blame the seedsman for sending us old seed, but think what the previous autumn has been like, whether it has been warm and sunny, so as to enable the food to be stored up in the seed in its proper condition to ensure it keeping perfectly during the winter.

In fact, when we understand our plants, the whole aspect of our work changes; and if we are, or if we want to become, gardeners, we are able to give an intelligent explanation about any part of our work to our employers, who, in turn, will think more highly of us.
The Potato is the most important of all our vegetable crops. It is seldom raised from seed, unless new varieties are required. Tubers are used (popularly, but erroneously, known as seed). These are enlarged underground stems, composed of thin-walled cells, which are filled with food substances, principally starch. These tubers are eaten as food. The first potatoes introduced into Britain were brought from Virginia in 1585, and planted near Cork, in Ireland. Vast improvements have been made in the quality of the Potato, and we have now not only many varieties to choose from, but also Potatoes suitable for early, midseason, or late crops.

The earliest kinds may be planted in warm soils as early as February, but this can only be done in places which are free from spring frosts, or where protection can be afforded on the appearance of frost. In all but these favoured places March will be early enough for planting tubers, and in some districts liable to late spring frosts, they should not be planted till the end of March.

There are several methods of planting, either drilling, planting with the dibber, or with the spade. Now the Potato must have plenty of air at the roots, therefore the method that allows most air to get into the ground is undoubtedly the best.
To begin with, the ground must be thoroughly cultivated and fairly well manured, though the crops from very rich soil are never of the best quality. In fact, the best potatoes, from a culinary point of view, are often taken from poor land, though the crops may not be large. It is better to spread the manure broadcast on the soil and dig it in, rather than allow the potatoes to come in contact with it. The roots will very soon ramify in all directions and obtain their food substances from the manure.

Some cottagers plant their potatoes as they dig; that is, they commence the digging of their ground, and as soon as they have dug a sufficient quantity they put on the line, make a small trench with the spade, and put in the manure. The potatoes are then planted on the top of the manure and covered over with the next spit of
soil as the digging proceeds. The line is then brought forward and similar operations repeated. Now this method would be very good if the manure were dug in, so that the potatoes did not come in direct contact with it. In this method you have no treading on the soil to make it too firm. The air is enabled to get to the roots, and the young tubers have a good chance to grow. By the time the plants appear above the soil the weeds will also be growing, therefore the hoe will require to be kept going to kill them and also to aerate the soil. Before the stems, or haulms, have grown too large they must be earthed up, otherwise considerable damage may be done with the handle of the hoe. Care must be exercised to leave a sufficient distance between the rows to allow of a good “earthing up”. If sufficient soil is not drawn round the base of the stems the young tubers will grow outside the soil, and consequently turn green from exposure to the light and sun, and therefore unfit for food.

Another method of planting is with the spade. After the ground has been dug and manured, the line is set and a spadeful of soil lifted out. The potato is then put in and the soil replaced on the top of it. This is not a good method, as in all probability the potatoes will be planted at varying depths.

The dibber, too, is frequently used for planting potatoes, but, though a quick and easy method of planting, it should not be used unless it is absolutely necessary to economize time. To begin with, the tubers may be planted at different depths. This may be prevented by placing a cross bar on the dibber to prevent it going too deeply into the soil. But in pushing the dibber into
the soil you must necessarily make the soil solid all round and beneath the hole where the tuber is planted. Now this will tend to exclude the air, and will prevent the roots from penetrating easily into the surrounding soil.

The best method of planting potatoes is with the hoe. When the ground has been dug and manured, measure out the required distances and mark each row. Two feet for dwarf-growing varieties (i.e. many of the early ones) and from $2\frac{1}{2}$ to 3 ft. for the stronger-growing should be allowed. Then set the line to keep the rows perfectly straight, and draw drills about 4 in. deep with the corner of the hoe, planting the tubers from 10 in. to 1 ft. apart, and cover over by drawing the soil up on either side with a three-pronged hoe or with a rake, leaving the ground loose and in ridges. This enables the maximum amount of air to penetrate to the roots of the plants. Care must be taken to draw the same amount of soil from each side, and the first half must be drawn to the centre of the drill; otherwise the plants will come up through the side of the drill. When they have grown up, and before they get too high, run through the drills with the hoe, killing the weeds and breaking up the surface soil. On the following day, or soon after, the plants can be earthed up again. This may require to be done twice in a season, before the haulms get too large.

When digging potatoes, great care must be exercised so as not to injure the tubers with the fork, especially if they are to be stored for future use, or required for replanting. The best way is to put the fork in at the
side of the drill, then to lift the entire plant out of the ground. If any of the tubers are injured they should be put aside for immediate use. Care must also be taken, when digging, to separate any tubers which show the least sign of disease, especially among those to be stored. On no account whatever should any diseased tubers be left on the soil, as they will simply infest the ground with disease germs. They should be destroyed, either by mixing quicklime with them or by burning. A full account of potato disease will be found in the chapter on plant diseases.

Potatoes for future kitchen use may be stored in clamps on the ground in a dry situation. A hole the required size may be dug 6 to 8 in. below the level of the soil and the soil thrown to either side. The perfect potatoes should then be put in and built up into a cone- or wedge-shaped heap. They should then be covered over with clean, long, dry straw, neatly laid lengthways over the clamp to a depth of 6 in. The whole should then be covered with about 10 or 12 in. of soil. Two 1-in. drain pipes should be placed in the top of the clamp in a vertical position. These, having been previously stuffed with straw, will allow the air to get in, and prevent any possibility of heating. The soil should be brought up to a point and made quite smooth with the back of the spade, to allow the rain to run off. The soil having been taken out all round to cover the clamp, there will be plenty of opportunity for the water to drain away from the storing place.

Potatoes required for replanting should be stored in boxes. They should be placed with the rose end, that
is, the end where the eyes are, uppermost. If the boxes are shallow, with a light frame above on which another box can rest, they may be placed one above another, thus allowing a free circulation of air through all the boxes. They should then be stored in a cool shed, where they will be free from frost. In spring, such tubers will throw out strong-growing sprouts. The potatoes, however, should not be handled till they are lifted out and placed directly into the drills where they are to go. New varieties are constantly being introduced by those who make a speciality of raising them, but the supply does not yet meet the demand. When we consider that it is an artificial way of growing our crops, can we wonder that certain of our best varieties deteriorate and become more liable to be attacked by disease? The best plan would be to imitate Nature's way of raising our potato crop more often than we do. In doing so we should select seedlings having the best qualities—(1) disease resisters; (2) good cookers; and (3) good croppers. Raising new varieties from seed is a long, tedious, but very interesting process, and further details will be given in the chapter on "Hybridization and Cross-breeding".
The Cultivation of Vegetables

The following are some of the best varieties in cultivation at the present time:

**Early Varieties**
- Midlothian Early Kidney, white.
- Wyatt's Ash Leaf Kidney, white.
- Sir John Llewellyn Kidney, white.

**Second Early Varieties**
- Britannia Round, white.
- British Queen Kidney, white.
- Windsor Castle Round, white.

**Late or Main-crop Varieties**
- The Factor.
- King Edward VII Kidney, coloured.
- Longworthy Kidney, white.
- The Crofter Round, white.
- The Provost Round, white.
- Up-to-date Kidney, white.

THE CABBAGE

To obtain good, tender hearts of this vegetable for as long a season as possible, successional sowings must be made. For an early crop in spring it is advisable to sow the seed in the previous July or August. In places where winter comes on early, the seed should be sown in July, but in the south of England August is early enough. If Cabbages are sown too early they have a tendency to run to seed, or "bolt", in spring.

The seed can be sown in lines on a border. Sow thinly to ensure sturdy and healthy plants. As these plants have to stand the winter, it is important that they should get a good start in the seed bed. When ready
for planting they ought to be put on ground which is not too rich; otherwise they may grow too rapidly and become soft, thereby being more liable to be injured by the severe weather during the winter. The Cabbage is a gross-feeding plant, and as it is the vegetable part of the plant which is eaten, and as this is more tender if grown quickly, it will be better to apply some quick-acting manure, such as nitrate of soda, in spring. This should be applied at the rate of 8 to 12 oz. per 10 sq. yd. two or three times during the growing season. It may be sprinkled over the surface of the soil during a slight rain.

Liquid manure from the tanks, or from the made-up barrels, may be used for the same purpose. Given once or twice a week, this will be specially suitable during dry weather.

Cabbages can be considerably hastened in forming good hearts if hand lights or bell glasses are placed over them. On very warm days these should be tilted on one side, thus allowing a circulation of air. If the ground can be spared in spring, when the cabbage has been cut, the root and the stem may be left. From this stem young shoots will break out, and if the plants have been vigorous, nice little cabbages will be produced later on in the season. When cabbages are wanted during as long a season as possible a small sowing may be made on an early, sheltered border in February. These will come on in succession to the autumn-sown ones. The main-crop sowing may be made from the middle to the end of March. Seeds should always be sown thinly, as the seedlings then get a chance to develop into strong,
healthy plants by planting-out time. For spring planting the soil can scarcely be too rich, and if it is naturally poor, abundant farmyard manure should be dug in, to ensure getting nice, sweet, and tender plants.

The soil for Cabbages should be thoroughly dug or trenched some little time before planting. Before commencing to plant, the ground should be measured, when the distances apart have been determined upon. This, of course, will depend upon the variety, whether it is a strong grower or otherwise. Generally speaking, the early varieties are not so strong-growing as the later ones, and may be planted closer together. From 12 to 18 in. between the plants in the row, and from 15 to 20 in. between the rows, is a good average. The main-crop varieties may be planted from 18 to 20 in. apart in the rows, and 20 to 24 in. between the latter. Late, strong-growing varieties may require 2 ft. between the plants in the rows, and from 2½ to 3 ft. between the rows. When the ground has been measured, the line should be stretched from side to side, and set tightly, after which the ground should be trodden down firmly where the Cabbages are to be planted. This is done by placing the feet close together on each side of the line, and treading along, leaving a slight ridge in the centre. Then proceed to the next line, and so on until the rows are finished. The slight ridge which is left will act as a guide to the planting.

The dibber is generally used in planting Cabbages. A large, deep hole should be made, so that the roots may not be doubled up and so prevented from carrying out their proper functions. A dozen plants may be taken
together in the hand. The one about to be planted should be held between the first two fingers of the left hand, at the point required to be level with the surface of the soil. This will prevent planting either too deep or too shallow. Then the dibber should be put in at an angle, thus fixing the soil well round the roots, and leaving a slight hollow round the neck of the plant to catch moisture for the root.

After planting, the hoe should be kept going among the plants, to kill the weeds, and also to act as a "soil mulch" in dry weather. If the plants are inclined to get "leggy", they should be earthed up to prevent the wind blowing them about.

Varieties—
  Early York.       Winningstadt.
  Ellam's Early.    Enfield Market.

THE SAVOY

This vegetable, which is very much like the Cabbage, may be treated in a similar manner. It is, however, used more as a winter vegetable, and only forms one head, which, unlike the Cabbage, has crinkled leaves. The seed may be sown during April, and planted out when ready, towards the end of May. A successional sowing may be made in May, planting out towards the end of June, and so spreading the season for their use as far into the winter as possible.

Savoys are hardier than Cabbages, and will stand a considerable amount of frost. It is not necessary to have
them earlier in the season, as Cabbages suit the spring and summer better.

The dwarf varieties are tenderer and better suited for garden use. They may be planted in the same manner as Cabbages, on fairly-well-manured and thoroughly cultivated ground, about 15 in. between the plants in the row and 18 in. between the rows.

**Varieties—**

- Drumhead.
- Dobbie’s Perfect Gem.
- Sutton’s Tom Thumb.
- Early Ulm.

**RED CABBAGE**

The Red Cabbage is principally used for pickling, and only differs from the ordinary Cabbage in its colour. Therefore, details as to its cultivation are the same as for the ordinary Cabbage. As it is desirable to have fine succulent heads, the ground should be thoroughly dug or trenched and very liberally manured.

**Varieties—**

- Sutton’s Dwarf Blood Red.
- Dobbie’s Selected Red.
- Large Blood Red.
These belong to the same family as the Cabbage and Savoy. They are essentially an autumn and winter vegetable, and should be treated as such.

Everyone is familiar with the long stem, the rounded leaves, the Savoy-like head, and the fine, small Cabbage-like sprout in the axil of each leaf stalk. They are more tender, as a vegetable, than any of the other members of this group of the family, and deserve a place in all gardens. The seed should be sown on a thoroughly dug border, and as soon as ready for transplanting, the plants may be placed in their permanent quarters. The plants should be from 15 to 18 in. apart in the rows, and there should be at least 2 ft. between the rows. The hoe should be kept going among the plants, and before they have grown too large they should be earthed up to prevent them from being blown about by the wind.

As the sprouts develop some people take out the top of the plant, which they use as a vegetable, thus allowing all the strength of the plant to go to the sprouts. The
plants should be examined regularly, and all dead or decaying leaves removed; otherwise they may cause injury to the sprouts themselves, besides spoiling the general appearance of the garden. Care should be exercised when picking the sprouts to take those which have matured first, or some may open out and be spoilt. Again, sprouts of the same size should be taken at each picking. If sprouts of different sizes are taken, and cooked together, some will be spoilt before the others are properly cooked.

Varieties—
Dobbie's Selected.
Sutton's Matchless.
Aigburth.

BORECOLE OR KALE

This is the hardiest of all the groups of this family, and is therefore suitable for supplying us with a nice, succulent green vegetable at a time of the year when there is nothing else in the open garden. This is why it should find a place in every garden, from the largest establishment to the smallest kitchen plot of ground.

Being so hardy, Kale does not require any special care, further than the ordinary care of sowing thinly, so as to get good, strong, healthy plants at planting-out time. The seed may be sown in April, and as soon as the plants are large enough they may be planted out in well-dug and well-manured ground, in rows 2 ft. apart with 18 in. between the plants in the row.

Kale will thrive on almost any soil, light or heavy, rich or poor. However, to get the best and most
succulent vegetable it will be found necessary to manure a poor soil liberally. On rich soils the stronger varieties may require to be planted 3 ft. apart each way. When grown for exhibition they must have plenty of room to develop, and plenty of light and air. At some shows this vegetable is a special feature. The point aimed at should be “size of head”, which should be finely curled, and crisp to the touch. It should be planted in the way advised for cabbages.

**Varieties—**

Dobbie’s Victoria Kale.
Sutton’s A1.
Thousand Headed.

When planting all the above kinds of vegetables from the seed beds, it is advisable to select dull, showery weather, so that the plants will not be checked too much. If the weather continues to be dry it will help the plants considerably if you go over the rows in the seed bed and move the plants very slightly with a fork. Then give them a good watering a few days before transplanting. This will cause them to make numbers of fresh roots, and the soil will cling better to them when lifted. When they are planted, the soil should be pressed well round the roots, and a little cup left round the base of the stem, which should be filled with water. If these precautions are taken, even in dry weather the plants will get practically no check on being moved. When plants are bought—as is sometimes advisable when only a small quantity of each is required—and the roots have got very dry, it is advisable to mix up a puddle for
them. This can be done by mixing together some ordinary garden soil, a small quantity of cow manure, and a 4-in. pot of soot, with sufficient water to make a thick paste. The plants should then be dipped in this mixture, separating the roots so that each gets a good layer of material all round it. If this is done immediately before planting, the roots are freshened, and new ones are formed more rapidly, thus avoiding inaction and perhaps the death of some of the plants, especially if dry weather continues.

CAULIFLOWER

This belongs to the same family as the Cabbage, Kale, &c., but is much more tender, and therefore requires more care in cultivation. It is, however, a much finer vegetable, and is worthy of the extra care devoted to it.

The first crop may be sown during the third or fourth week in August, on a border where the soil is naturally light, or has had loam or leaf soil dug into it. The seed should be sown thinly, in lines about 4 in. apart. If the weather is hot and dry the soil may be covered with a mat to prevent excessive evaporation until the seeds have germinated. Great care must be taken not to leave the mat on too long, or the seedlings
may be ruined. About three weeks after the plants have come up they should be pricked out into a cold frame, the soil of which should be a nice loam with a little leaf soil and sand. The plants should be placed from 4 to 6 in. apart. The surface of the soil in the frame should be about 8 or 9 in. from the glass. If more than this, the plants will be drawn up and weakened. They must be kept as cool as possible to prevent growth from going on too rapidly and the plants becoming soft, and therefore not able to stand the severe weather of winter. A thin layer of lime should be spread round the inside of the frame to prevent slugs getting at the plants in winter. Air must be given to the plants on every suitable occasion, and especially in severe weather, thus allowing the frame to dry properly and prevent “damping off”. When the days begin to lengthen, and the weather to improve, all air possible should be given, until the sashes can be thrown off altogether. They should, however, be kept handy, in case of emergency.

About the end of February, if the weather is favourable, the plants may be lifted, with good balls of soil attached to the roots, and planted out on a warm south border. If the weather afterwards becomes severe, the plants should be covered over at night with large pots or hand lights, which can be taken off during the day. In this way nice heads should be obtained towards the end of May or early in June, according to the climatic conditions of the district.

For the second crop the seed may be sown thinly in a box, frame, or greenhouse, about the beginning of February, and as soon as ready they may be pricked out
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into a cold frame, as stated before, or they may even be pricked out on to a sheltered warm border, if the soil is good and loamy. By the end of April they should be ready for planting into their permanent quarters. These should follow the autumn-sown ones in giving a supply of nice young heads.

The seed for the main crop may be sown in the open garden on a border of good, rich soil, about the middle of April. Sow the seed thinly, in rows 1 ft. apart, where they may remain until they are ready for planting out. After the plants have appeared, the hoe should be kept going between the rows to keep down the weeds, and also to act as a soil mulch in dry weather.

By the beginning of June the plants should be ready for transplanting. This can be done with the dibber, as advised for Cabbages. These should come on in succession to the second crop, and should give nice heads until the frost comes and cuts them down. Great care should be exercised never to let the Cauliflowers get dry, or a check in this way may cause them to form small, useless heads early, or, as gardeners say, "button". If the weather is at all dry at planting time, a broad cup should be left round each plant, and copious supplies of water given. After planting, the hoe should be frequently used to keep down the weeds, and also to conserve the moisture in dry weather. If the plants are inclined to be at all leggy, they should be earthed up to prevent the wind from twisting them off at the neck. If the leaves are not a sufficient protection from the sun, some of the larger ones may be turned over the flower, thus keeping it nice and white, otherwise the sun causes it to become
yellowish. This may also be done as a slight protection against frost.

*Varieties—*

- Early London.
- Early Erfurt.
- Magnum Bonum.
- Sutton's Purity.
- Walcheren.
- Veitch's Autumn Giant.
- Eclipse.

**BROCCOLI**

The Broccoli is very much like the Cauliflower; in fact, some writers have thought that they were raised from Cauliflowers. However that may be, we know from the much hardier constitution of the Broccoli that there is a distinctive difference between them and the more tender Cauliflower.

They come in during the autumn, early winter, and spring. In mild seasons we may have them almost throughout the winter. They like a good loamy soil, but if it is rich they are inclined to grow rank, and less able to withstand the rigours of a severe winter. It is also better to grow them on the most exposed spot that is possible, as they are quite hardy from the beginning. The seed should be sown during April or May for the early and late sorts, on a thoroughly well-cultivated and good soil. The rows should be 1 ft. apart, and if the seed has been thinly sown, the plants may remain until ready for planting out, which should be done as soon as they are large enough. Dull, showery weather should be selected for the purpose, and if afterwards necessary, water should be applied until they are established, as a check at this season may cause them to form heads pre-
maturely. Though many Broccoli are very hardy, yet in severe winters it is often necessary to protect the plants by some means or other. One of the simplest methods is to loosen the plants with a fork, and turn their heads towards the north, or two rows together may be loosened and inclined towards each other, or they may be covered over with straw or mats. If the heads have been partly formed, they may be lifted and placed close together in a shed, and their roots covered with soil, where they may be allowed to mature. This latter method would only apply to a few plants at one time. If these methods are adopted a supply of cauliflower or broccoli may be obtained the whole year, except when the winter is unusually severe.

Varieties—
Backhouse's Winter, white.
Snow's Winter, white.
Veitch's Self-protecting.

THE TURNIP

Though so unlike the Cabbage, Kale, or Cauliflower, the Turnip belongs to the same great family of plants. In the former we eat the leaves, or flower, while in the turnip we eat the swollen, succulent root. During the growing season, the plant stores up large quantities of food material in the thin-walled cells of the root; most of which would be used up the following year to produce the flowers and seeds. However, we have found that this root forms excellent food for both cattle and man; hence, when it is fully stored with food, we utilize it as part of our diet.
In growing the Turnip the soil should be thoroughly well cultivated, and fairly well manured. It should not be too rich; otherwise the roots may split, or form several small, useless roots (finger and toe). The first sowing of early varieties may be made on a warm border, when the weather is suitable, during February, and successional sowings may be made at intervals as required until the end of June. The Turnip succeeds best in moderately light soils, and does not do well in stiff clayey ones. The seeds should be sown in drills 15 in. apart for the smaller varieties, and 18 in. apart for the stronger-growing kinds. Drills should be drawn 1 in. deep, the seed sown thinly, and the soil covered in with the feet, thus pressing the soil on the top of the seed and preventing the excessive evaporation of moisture from the loosened soil. This enables the seeds to germinate regularly. As soon as the plants appear, the hoe should be kept going to kill the weeds and conserve the moisture. When the plants are about 2 in. high they should be thinned out, the earlier varieties being left about 3 in. apart. When the
roots are a fair size, every alternate one may then be taken out for present use, leaving the others room to mature. The late, stronger-growing varieties, may be thinned out to 6 or 8 in. apart, after which the principal work will be to keep the ground free from weeds. The Early Red Milan can be grown very successfully if sown thinly on fairly rich soil, and not thinned out at all. As the roots grow they push each other upwards, the taproot lengthening as growth goes on. By this method you can economize ground space, as you can keep pulling, which gives the others more room to develop. You thus get a supply of succulent young turnips for a long season from a small space of ground. The Turnip, like most other plants, has its insect pests and diseases to retard its growth, or even to spoil the entire crop. A full description of these will be given later on.

Varieties—

Dobbie's Golden Ball. Orange Jelly.
Sutton's Early Six Weeks. Early White Milan
Snowball Early Red Milan.

THE CARROT

Though we use the root of the Carrot as we do that of the Turnip, it belongs to a totally different family, for plants are classified by the flower or reproductive organs, and not by general appearance.

From the nature of the long taproot which we use, it will be clear to everyone that we ought to have a deep and well-cultivated soil for our crop of Carrots, and a soil which will allow the small taproot to penetrate easily during the early stages of its growth. A stiff clayey
soil is therefore not suitable, while a light sandy soil sometimes gets so hot in early spring that it checks the growth of the crop before the root is thoroughly established. A light soil, however, is most suitable for an early crop. On such a soil the seed can sometimes be sown a month earlier, with the very best results. A good peaty soil will grow exceptionally good crops of Carrots. As the root may go down 2 or 3 ft., the soil ought to be trenched to that depth, or even deeper, and it should not be too rich. A piece of ground which has been heavily manured the previous year—as for Celery, for instance—will be suitable without the addition of any farm-yard manure. If the soil is too rich, the root will "fork out" into several branches, instead of forming one nice, long, thick taproot; or, if it forms a single root, it is apt to split. The first sowing may be made at the end of February, or beginning of March, on a nice warm early border, the short-horn varieties being used, while a successional sowing of the same kind may be made until the end of March. The main crop should be sown during the first week in
PLANTING ONIONS

MAKING HOLES FOR CARROTS
April, using the long varieties, which are more especially suited for winter use.

The seed should be sown thinly in drills 1 ft. apart and 1 in. deep. It should also be trodden in, as is the case with all small seeds. Some care will have to be exercised in the sowing, as the seed is prickly and does not separate easily. When the plants appear, the hoe will have to be run between the rows, and the plants thinned out before the roots have time to get entangled. A dull, showery day should be chosen, if possible, for thinning out. Should the soil be loosened, or dragged from the roots, so as to leave them bare, it should afterwards be again drawn up round the base of the leaves. If the weather is showery, the rain will firm the soil round the roots. They may be thinned out to 2 in. apart to begin with, the alternate ones being taken out at the next thinning, when the young roots are fit for use. After thinning, the hoe will have to be kept going between the rows, not, however, going too close to the carrots themselves. If exhibition roots are desired, some special means must be adopted to get the fine, beautifully tapered high-coloured roots of fine quality and size which we see occasionally on the exhibition table. They must be grown in prepared soil, and the most convenient method is to get the line as before, then, with a crowbar, make holes from 2½ to 3 ft. deep, and about 9 in. apart. These should be filled up with the prepared soil, leaving it to settle down for a few days before sowing the seed. The prepared soil may be made up of 3 parts sifted loam, 1 part wood ashes, 1 part leaf mould, and ½ part sand, to keep it free and open, with a sprinkling of guano.
The roots penetrate this soil very easily, and also have time and space to broaden. They also come out of such soil with high colour, and of fine quality. Three or four seeds may be sown in each hole, near the centre, and before they grow too large they should be thinned out, leaving only the best in each hole or the best that is nearest the centre.

Main-crop Carrots will require to be taken up before the frost sets in. This should be done with care. The leaves should be cut off, and the roots stored in sand or slightly damp ordinary soil, in a suitable shed from which severe frost will be excluded. A layer of sand should be put down, then a layer of carrots, then another layer of sand, and so on, until they are all stored. In this way they can be kept quite fresh during the winter.

If young carrots are desired earlier than they can ordinarily be obtained from the garden, a hotbed may be made of long, fresh horse manure, mixed with half-decayed leaves. This should be built up in the form of a square, and a light frame placed over it. In this about 1 ft. of fine soil should be put, and the seed of the short-horn carrots sown in lines about 6 in. apart. The seeds should be sown thinly, and should not require thinning until ready for use. Such tender roots are very much prized early in the season.

Varieties—

Ryder’s Scarlet Horn.                James’s Scarlet Intermediate.
Sutton’s Champion Scarlet Horn.     Altrincham.
Dobbie’s Selected Stump Rooted.     St. Valloy.
Like the Carrot the Parsnip has a long taproot which is used as a vegetable. It is a stronger-growing plant than the Carrot, and, as the root goes deeper into the ground, it is essential to have a deep and well-cultivated soil for its growth. It ought to be cultivated 3 or 4 ft. deep, in ground that is not too rich, or the roots will either be divided and useless, or coarse in quality.

Being hardier, and requiring a longer season for its growth, it should be sown as early as possible, when the ground is in a suitable condition at the beginning of March. Sow in lines 18 in. apart and 1½ in. deep, the seed being covered over with soil pressed down with the feet. When the plants are about 2 in. high, they should be thinned out to 10 or 12 in. apart, after which the hoe should be kept going between the rows. For exhibition Parsnips similar methods should be employed. As in the case of Carrots, a crowbar should be used, and the holes made from 2½ to 3 ft. deep, and from 12 to 15 in. apart, after which they should be filled up with prepared soil, thus giving a free material into which the slender roots can easily penetrate during the early stages of their growth. In filling the holes, care must be taken that only small quantities of soil are put in at first, or an empty space may be formed in the prepared place, which will have the effect of either stopping growth in length, or will cause the root to grow sideways and thus spoil its appearance.

During October or November the roots may be dug up carefully, the leaves cut off, and then stored in sand or ordinary garden soil, as advised for Carrots. To build
the heap properly, it is necessary to place the heads of the roots on the alternate sides, and also a few in the centre, thus keeping the layer level.

The Parsnip is not, as a rule, liable to be attacked by disease or insects, yet it occasionally happens that insects do attack them. For remedy, see chapter on “Insects”.

Varieties—

Dobbie's Selected.
The Student.
Hollow Crowned.

THE BEETROOT

Beetroot is another of our garden root crops which is extensively grown in all parts of the country. It differs greatly from other root crops, being more tender, and requiring more careful handling. There are two distinct kinds of Beetroot, viz. the turnip-rooted, and the long-rooted kinds. In some districts the turnip-rooted kind is preferred, whilst in others the long kind is better liked and more extensively used.

The soil must be thoroughly cultivated and should not be too heavy. A loamy or rather light soil is best suited to produce roots of the highest quality; but, however suitable the soil may be, the Beetroot must be exposed to the sun or the best results will not follow. We can realize this more fully when we know that a large proportion of the food stored in the beet is sugar. We first get starch \( (C_6H_{10}O_5) \), manufactured in the leaves through the action of sunlight, and this is converted into sugar \( (C_{12}H_{22}O_{11}) \) at a later stage. If grown in the shade, the
work goes on more slowly, and therefore the roots are not of such a high quality.

Being delicate, the seed should not be sown until the weather is fine, and there is little fear of injury from frost, for the main crop at least. This will probably be about the middle of April. As the seed of the Beet is somewhat expensive, it is advisable to be as economical as possible in the sowing of it. Therefore, when the line is set and the drill drawn, instead of sowing the seeds all along the drill, three or four should be placed in little clumps 6 to 9 in. apart. This will not only save seed, but will economize time when thinning, as only the clumps will require thinning out to one plant each. The drills should be 1 5 in. apart and 1 1/2 in. deep. When the plants are 1 1/2 to 2 in. high they should be thinned out, a dull day being chosen for the purpose if possible.

If an early batch is required, a small quantity of the turnip-rooted variety may be sown about the middle of March, in a more or less sheltered position, but exposed to the sun.

The hoe should be kept going between the rows, to keep down weeds and to conserve the moisture in dry weather. Great care must be exercised not to cut the roots with the hoe, or bruise them by pushing stones against them, as they bleed readily. It will be better to pull the weeds out by hand round the plants, and only hoe in the middle, between the rows. For the same reason, care must be taken not to break the leaves.

The crop must be taken up before the frost has any chance of injuring it. This will be from the middle of October to the first week in November, according to the
season and locality. Again, care must also be exercised not to break the roots when getting them up. A trench should be dug out to the depth of the roots, for the first row, and the roots taken up carefully, afterwards digging over the soil into the trench from the next row, lifting it, and so on. In taking off the leaves they must not be cut too close to the crown, or the plant will bleed and so lose its colour. They should be stored in sand, as advised for Carrots and Parsnips, in a cool shed from which frost can be excluded, Birds are particularly fond of the sweet young leaves of the Beet. When the seed is sown, therefore, black cotton should be stretched over the rows about 1\(\frac{1}{2}\) or 2 in. above the soil. This is a simple but sure preventive.

**Varieties—**

- Dobbie’s Purple, long.
- Sutton’s Blood Red, long.
- Veitch’s Red, long.
- Dobbie’s Selected Globe, round.

**THE RADISH**

This is another root crop which is extensively grown, especially for spring use, because at that time of the year there is sufficient moisture in the surface soil, and also sufficient heat, to cause them to grow rapidly. They are then crisp and sweet, whereas, later in the season, when it is warm and the surface soil becomes more or less dry, they are pithy and hot. They grow well on almost any soil during spring, and can be sown either broadcast or in drills 1\(\frac{1}{2}\) in. deep. The seed should be sown thinly, and no thinning will be required, as by pulling up the
largest ones for use the others are given room to develop. The first sowing may be made in the open ground about the beginning of March, and successional sowings may be made every fortnight as long as they are required.

An early batch may be obtained at the end of January by making a hotbed of fresh horse manure and partly decayed leaves, treading the whole firmly so that the heat will not be too great at first, and therefore retained longer. A light frame should afterwards be placed over the bed, and from 6 to 8 in. of loamy soil put into the frame. The seed should then be sown, either broadcast, thinly, or in rows 6 in. apart. As soon as the first roots are large enough they should be pulled up, thus giving the others space to develop.

Varieties—

French Breakfast.   Turnip Red.
Turnip White.       Wood’s Frame.

PEAS

Peas are cultivated for the seeds they produce, which, as everybody knows, form an excellent and wholesome article of diet.

They succeed well in almost any kind of garden soil, though some varieties appear to thrive better on particular soils.

For instance, two varieties, A and B, may be tried in a garden. Should the season be a dry one, A may do exceptionally well, while B is a failure. This will not satisfy a keen and intelligent gardener, so next season the same varieties are experimented with again. Should
the second season happen to be a wet one, A may produce a very poor crop, but B an excellent one.

This may not be quite so clearly marked as stated here, still, on the same soil there is often a marked difference in the productive qualities of some of the varieties, all depending upon the character of the season.

With so many varieties to choose from, and a little careful observation and experiment, it may very soon be found out which kind suits a particular soil in any season. Peas, in common with all leguminous plants, have the power of utilizing
The cultivation of vegetables.

The nitrogen gas of the atmosphere, as one of the most valuable plant foods, viz. the nitrates. If the root of a pea or other leguminous plant be examined, little nodules or swellings will be found all over it. This is not a disease, as was at first supposed, but these little nodules, when cut through with a razor and examined under the microscope, are found to be full of tiny moving living things. These are bacteria, the most minute organisms imaginable. They extract the nitrogen gas from the atmosphere and change it into nitrates in their bodies, after which it is absorbed by the pea plant as its food. Nitrate is one of the principal ingredients in farmyard manure. Peas do not require a large supply of this manure. Soil which has been well manured the previous year will generally be found to be rich enough for them, but the soil must be thoroughly dug or trenched.

The first sowing may be made as soon as the soil is in order in March. The line having been properly set, drills about 3 in. deep should be drawn with the flat of the hoe, the handle of the hoe being held fairly high, cutting the soil rather than drawing it, thus allowing it to fall out to either side of the drill. The seed should be sown thinly, allowing at least 2 in. in all directions between the seeds. They should then be covered up with the rake, pushing half the soil in from one side, and pulling the other half in from the other, leaving a very slight ridge along the centre of the row.

It is not necessary to tread the soil on the top of the seeds in this case, as they are deep enough in the soil to ensure them being kept uniformly moist until germination has taken place. As birds are very fond of the young
leaves of the pea plant, the latter must be protected or they will be eaten as soon as they appear above-ground. The most economical and effective way of protecting them is to stretch black cotton from one end of the row to the other. The sticks holding the cotton should be of such a height that the strands can be stretched about $1 \frac{1}{2}$ or 2 in. above the soil. The birds come in contact with the cotton, and, being unable to see it clearly, are frightened, and fly off. Another method is to have wire protectors. These are expensive, but when obtained will last for years, and, of course, are quite effective. They must, however, be removed before the plants have time to grow through them. When the plants have made 2 or 3 in. growth they should be staked. Good branching stakes should be procured early in the season, and the height carefully taken, making an allowance of from 6 in. to 1 ft., in case the season should prove wet, otherwise the plants may overgrow the stakes and double over, thus partly spoiling the crop. If a day be chosen after a good rain the stakes will easily go into the ground. They must be made firm, or when the plants have grown and formed a thick screen the whole is liable to be blown over if there should be a strong wind. The tops of the sticks should be cut off level, the small twigs being stuck in at the bottom to give the plants a good start. Sticks, where procurable, are better for supporting the pea plants than the wire trainers, although, of course, in some districts sticks are not to be obtained. The plants do not cling so readily to the wire as they do to the wood, and if they grow out sideways they must be tied up with coarse, strong twine, to prevent the wind or rain from breaking them
NARCISSUS NATURALIZED ON BANK OF STREAM
The Cultivation of Vegetables

down. When picking the pods, care must be taken to see that they are quite full—that is, that the peas inside have made their full growth. The appearance of the pods sometimes leads one to believe they are full when they are not. Several should be opened and examined, while the others may be very slightly pressed with finger and thumb. In picking, the basket should be suspended from the waistbelt, thus leaving both hands free—the one to hold the stalk, while with the other the pod is pulled off, preventing pulling up or breaking the plant.

If peas are required for exhibition purposes, special means will have to be adopted to get the fine large pods quite full with the richly coloured peas which are seen on the exhibition tables in the largest horticultural exhibitions.

When a good position has been selected in the garden for such Peas a trench should be taken out, 12 to 18 in. deep, and filled up to within 4 in. of the surface with a specially prepared soil, made up of 6 parts chopped loam, 1 part leaf soil, 1 part wood ashes, and 1 part manure from a spent Mushroom bed or well-rotted horse manure, and to every barrowload a 6-in. potful of bone meal should be added. When the trench has been filled with this compost the seed may be sown as soon as the soil has settled down, which it will do in a day or two. The peas should be planted 4 in. apart, and then covered over with 3 in. of the same compost. "Staking" should afterwards be done in the usual way, and when the plants have set two or three pairs of flowers the tops should be pinched out, thus allowing all the nourishment to be directed into these pods. It may, at first sight, seem a waste to do this, but the finest
peas that can possibly be produced are treated in this manner, and the extra size of peas and pods fully compensates for the deficiency in numbers.

*Early Dwarf Varieties*—

- William Hurst, 12 to 15 in. high.
- English Wonder, 20 to 24 in. high.

*Early Taller Varieties*—

- William the First, 2½ ft.
- Gradus, 3 ft.
- May Queen, 2½ ft.

*Second Early*—

- Stratagem, 2 ft.
- Prince of Wales, 3 ft.
- Early Duke, 3½ ft.
- Duke of York, 3½ ft.

*Main-crop and Late Varieties*—

- Alderman, 5 ft.
- Duke of Albany, 5 ft.
- Veitch’s Perfection, 3 ft.
- Autocrat, 4 ft.
- The Gladstone, 3½ ft.

**BROAD BEANS**

Broad Beans are found in most gardens, and when well grown form a very excellent vegetable. They are not, however, appreciated by everyone.

A good strong loamy soil is most suitable for growing the finest crop, but Broad Beans succeed fairly well in almost any good garden soil. They seldom succeed well if the soil is very light, unless they are sown in the autumn or very early spring. The soil should be thoroughly dug
or trenched, but should not be too rich; otherwise the plants will grow luxuriantly, but there will be few pods, and those of inferior quality.

On light soils they may be sown during November or December, in a fairly exposed position, so as to keep them quite hardy from the beginning.

On other soils the first sowing may be made in February, in drills 2½ to 3 in. deep. As they grow fairly tall, and shade each other if the rows are close together, the best way is to draw two drills about 10 in. apart, and plant out the beans about 6 in. apart in the rows, having the seeds in the second row alternating with those in the first, thus forming a double row. These double rows should be 4 to 6 ft. apart, planting one or two rows of Cabbages or Cauliflowers in between. In this way it is easier to get among the tall plants, to keep the ground free of weeds, and to gather the crop.

There are other methods of sowing Broad Beans, such as putting them in with the dibber. The latter, however, must be blunt-pointed, to ensure the seeds resting entirely on the soil; otherwise they may be suspended in the hole, and not grow satisfactorily. Then again, by this method there is the danger of planting the seeds at varying depths, thus giving an irregular growth. Beans may also be sown in single rows 2 ft. apart and 3 in. between the seeds, but neither of these methods is commendable.

When a good crop of pods is set, the tops of the plants may be pinched out to a depth of 3 in. This will check the top growth and send a larger supply of nourishment into the pods, and thus increase the quantity and quality of the crop.
Sometimes, when the plants grow tall, they require support. This can be given by driving in stout stakes at the end of each row, and stretching two strings, one on each side of the line. Some people prefer the beans very young, before they are fully grown, while others prefer them at a more advanced stage. This will, of course, determine when the crop is to be gathered.

For insect pests, see Chapter XV.

Varieties—
Bunyard's Exhibition Long Pod.
Improved Green Long Pod.
Selected Broad Windsor.

DWARF BEANS

Dwarf Beans form another valuable addition to our kitchen-garden crops. They succeed fairly well on almost any garden soil, provided care is taken to get them sown at a proper time. They are very tender, and very cold winds or a slight frost may practically ruin the crop; therefore they must not be sown until the weather is quite favourable. Of course if an early batch is required a few may be risked, which in favourable seasons may come on very well. This should be done early in April, but the main crop should not be sown until the beginning of May, successional sowings being made till the middle of June. They should be sown in drills 2 ft. apart, and two seeds $\frac{1}{2}$ in. apart should be placed at distances of 10 to 12 in. in the rows. As they do not always germinate regularly, when they are thoroughly established they should be thinned out, leaving single plants 10 to 12 in. apart in the rows. The ground should afterwards be kept
clear of weeds, and also frequently stirred up deeply with the hoe, to aerate the soil, and also to act as a mulch in dry weather. As the pods are cooked when young and tender, the plants should be looked over frequently when the pods have made fair growth, picking those which are ready from all the plants rather than waiting until many are ready on one plant.

Varieties—
Canadian Wonder. Everbearing. Plentiful.

CLIMBING FRENCH BEANS

These are also tender, and must be sown late, as advised for Dwarf Beans. They, however, climb, and require some support, either by sticks or poles driven into the soil at the end of each row, and stout cords stretched just above the soil, and also at the top. Cords should then be stretched vertically from the bottom cord to the top one, close to each plant. The plants will twine round these, thus getting the required support. They continue to bear for a longer time than the Dwarf Beans, and yet retain their delicate flavour. They may be sown in single rows 3 in. deep, and from 6 to 8 in. apart in the rows.

Varieties—
Sutton’s Earliest of All. Sutton’s Tender and True.

RUNNER BEANS

These form a very useful crop in the vegetable garden. When they commence bearing—generally during August—they will go on producing pods until the frost cuts them down.
They succeed fairly well in almost any garden soil, though the best crops are obtained from a well-cultivated, good, loamy soil. They grow so tall, however, that a position should be selected for them where they will not unnecessarily shade other crops.

They are extremely tender, and require to be sown late in the season, about the beginning of May. Two drills should be drawn, 3 in. deep and 1 ft. apart, and the beans planted 12 in. apart in the rows, the second row alternating with the first. Soon after the plants come up a single stake should be put to each plant. These stakes should be drawn together at the top, and crossed. A stick should then be placed along the top, and the upright stakes tied to it, thus keeping the row perfectly steady. When the pods are large enough, the rows should be looked over frequently, and those which are well grown picked for use before they get too old. If exhibition pods are required, a trench should be taken out 18 in. deep, and filled to within 6 in. of the top with made-up soil, composed of 6 parts good decayed loam, chopped up, 1 part of well-rotted horse manure, 1 part wood ashes, and 1 part of leaf soil, with a 6-in. pot of bone meal to each barrow-load of soil. The seeds should be planted in a double row, 12 in. apart, with a distance of 12 in. between the rows, the seeds alternating with each other.

If an early crop is required, the seed must be planted singly in small pots, and placed in a cold frame, the plants being set out when the weather is favourable, before they get potbound. When the pods have formed, some of the plants may be "pinched", but considerable experience is required to time the growth of the pods to enable them to
The Cultivation of Vegetables

be at their best by a certain date. Care and strict observation are necessary in timing any of our crops for a certain date, but it must be given by those who wish to exhibit.

Varieties—
Sutton's Prizewinner
Dobbie's Champion Scarlet Runner
Giant White

THE ONION

The Onion is a very important crop in the kitchen garden, and some care must be taken with it to ensure a supply of this most wholesome vegetable during the whole of the year.

They are very deep-rooting, and also very gross-feeding plants, therefore the soil must be thoroughly trenched 2 or 3 ft. deep, if possible during the winter, putting in a good layer of cow manure to each spit, and leaving the surface as rough as possible in ridges exposed to the action of the frost.

The spring crop should be sown towards the end of March, if the soil can be got into the proper condition. On a fine day the ridges should be broken down with the fork, a good dressing of soot applied and raked in roughly, after which it should be made thoroughly firm by treading it down. This will break up the clods. Then it should be raked over finely, the ground marked out at
each end for drills 1 ft. apart, after which the line should be stretched across and the drills drawn—quite level—1 in. deep. The seed should be sown thinly along the drills, or, to economize seed, three or four seeds may be sown in clumps 6 in. apart. As soon as the plants appear above the soil the hoe should be kept going amongst them. When they are 3 or 4 in. high they should be thinned out to 3 in. apart, and when they have made sufficient growth to make them suitable for using as spring onions, every alternate one may be pulled out as they are required for use, leaving the permanent plants, which should be about 6 in. apart, to mature. The clumps, if the seed has germinated well, may be thinned out to one plant each. These should also be about 6 in. apart. The hoe should be kept going among the crop, to keep down weeds, and also to act as a soil mulch when there is an absence of rain. In dry weather, if a thorough soaking of water can be given once or twice a week, it will very materially assist the crops, especially in the younger stages of their growth. A slight sprinkling of water, however, is worse than useless, as it encourages "surface rooting", which should be avoided. A thorough soaking, or none at all, should be the rule. The roots would then make their way deeply into the soil, where there is usually sufficient moisture for the needs of the plants.

**Autumn Onions.**—For these the seed should be sown in lines 1 ft. apart, as advised for the spring crop, from the beginning to the middle of August. The young plants, however, should not be thinned out until spring, when they may be thinned as required for use, leaving the permanent plants about 6 in. apart.
Onions for Exhibition.—To grow bulbs from 19 to 21 in. in circumference requires a special method of culture, but the interest of watching, week by week, the progress made by the crop, and the very idea of being able to grow magnificent specimens, are incentives to work, and the fine results will amply repay the extra trouble entailed.

The seeds should be sown very thinly in pots or boxes as early as possible in January, and placed in a gentle bottom heat in the greenhouse, or in a frame on a hotbed. The soil used should be made of 3 parts of sifted loam, 1 part leaf soil, and ½ part of well-rotted horse manure, with a sprinkling of sand. When the plants have made about 1 in. of the second leaf, they should be pricked off—the soil recommended will allow the roots to come out freely. The tiny plants should then be put into boxes 2 in. apart each way. In planting, care should be taken not to double up the roots. The hole should be made large enough with the dibber to allow the roots to go right down into it; then firm the soil well round the roots. They may again be placed in the warm frame or greenhouse until they begin to grow, when they should be gradually hardened off. By the beginning of April they should be able to stand without the glass, and from a week to a fortnight afterwards they should be planted out.

The ground should be thoroughly trenched in autumn, putting in large quantities of manure, cow manure for preference, and, if possible, a quantity of good loam. In spring a good dressing of soot and also bone meal may be given, the soil being again broken down and made very firm. The whole should then be raked over, and the onions planted in rows 15 to 18 in. apart, with a space
of 12 in. between the plants in the rows. The plants should be set about \( \frac{1}{2} \) in. deep, to prevent them from being blown about by the wind. This soil may be scraped away with the finger when the bulbs begin to form. Copious waterings should be given in dry weather, preferably in the very early morning. When given in the evening the evaporation from the soil during a chilly night may check the growth of the plants at an important time. The hoe should be kept going among the crop to keep down the weeds, &c. Strict watch should be kept, and measurements taken of the bulbs, so that, should they not make regular progress, some stimulant can be given, such as liquid manure from the tanks connected with the cowsheds, or some of the mixed manures, the latter at the rate of 1 oz. to 1 gall. of water. As the season advances, and the bulbs begin to ripen, the necks may be twisted and turned down, thus entirely checking top growth. This tends to ripen the bulbs.

They should be lifted before the season is too far advanced, and thoroughly dried in the sun, always shielding them from rain. In this way the bulbs become well matured, and, when stored, will keep well during the winter. Onions should be stored by being spread out thinly on shelves in a dry, cool, airy shed.

**Varieties—**

**Spring Sowing**

<table>
<thead>
<tr>
<th>Variety</th>
<th>Varieties</th>
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<tbody>
<tr>
<td>Ailsa Craig</td>
<td>Bedfordshire Champion</td>
</tr>
<tr>
<td>Sutton's A1</td>
<td>Bousham Park Hero</td>
</tr>
<tr>
<td>Cranston's Excelsior</td>
<td>James's Long Keeping</td>
</tr>
</tbody>
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**Autumn Sowing**

<table>
<thead>
<tr>
<th>Variety</th>
<th>Varieties</th>
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<tbody>
<tr>
<td>Giant Rocca</td>
<td>Globe Tripoli</td>
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</tbody>
</table>
THE LEEK

The Leek is one of the most useful of all winter vegetables. It is perfectly hardy, and for the ordinary crop is extremely easy to grow, as the seed may be sown on a border, and when the early potatoes are dug the plants may be planted out in the place formerly occupied by the potatoes. The Leek is a gross-feeding plant, and requires a good, rich, and well-cultivated soil. The seed may be sown from the middle to the end of March, on a border which has been well dug or trenched, and plentifully manured. Sow thinly in drills 1 ft. apart and 1 in. deep. When the plants appear, the hoe should be kept going among them, to stir up the soil and keep down the weeds. By the middle of June, when the early potatoes are ready for use, the plants will be in good condition for transplanting. After the potatoes are taken up the ground should be dug over again and manured, after which the Leeks should be planted in rows 18 in. apart, with 4 to
6 in. between the plants in the row. Some cottagers cut off part of the tips of the roots, and an inch or two from the end of the leaves. This is a most objectionable practice.

A deep furrow should be made with the corner of the hoe—after the line has been set—where the Leeks are to be planted. A deep hole should then be made with the dibber. In the centre of this hole let down the Leek plant, until only its apex is above the hole in the bottom of the drill. Fill up loosely with soil. Dull, showery weather, if possible, should be selected for transplanting; then by the time the hoe is required the plants should have made some growth. As the season advances, and the plants grow up, some soil may be drawn up round them. In this way, even for the ordinary crop, nice, long, and well-blanched Leeks may be obtained. They will stand in the ground during winter, and may be taken up as required.

Leeks for exhibition, however, require much attention, and in the north this is ungrudgingly bestowed upon them. It is there especially that the Leek is grown to the greatest perfection. Even amongst the cottage gardeners keen rivalry is manifested in growing Leeks for exhibition purposes.

The seed is sown in soil similar to that recommended for the Onion. It should be put in pots or boxes early in January, and placed in the greenhouse or in a frame on a hotbed. When the young plants have made a second leaf they should be taken up carefully and potted into small pots, in soil composed of 3 parts loam—finely broken up—1 part leaf soil, and 1 part of well-decayed horse manure, with a little sand to keep it open. These pots should
TYING COLLARS ON LEEKS

TYING LETTUCE
be put back into the bottom heat for a week or so, until
the plants have thoroughly taken to the new soil, after
which they are gradually hardened off. If necessary, they
may be potted into 6-in. pots. By the middle of April
they should be quite hardened off, and able to do without
the sash being on the frame. By the beginning of May
they should be planted out. A trench should be made,
2 ft. broad and 2 ft. deep. Into this should be put 6 in.
of thoroughly decayed farmyard manure, and on the top
of this put about 12 in. of specially prepared soil, 4 parts
loam (chopped up), 1 part well-rotted horse manure, and
$\frac{1}{2}$ part of wood ashes, with a 6-in. potful of bone meal to
every barrowload of the mixed soil. The Leeks should
be planted in this, and, when they have made some growth,
paper collars should be put round the necks of the plants.
The collars should be about 4 in. broad, and will cause
the centres of the plants to draw up. When the centres
have grown above the papers, the latter should be drawn
up higher, and leaf mould—if possible—put round the
bottom of them. Boards should be placed along the sides
of the row, 6 in. from the plants. These will keep the
leaf mould round the plants, and allow them to be watered
and fed with liquid manure between the boards and the
sides of the trench. As the plants grow, the papers should
continually be drawn up higher and more leaf mould added.
More boards should also be added, as required, until the
full amount of "blanch" is obtained. From 14 to 16 in.
of blanch is quite sufficient. After they have made this,
they should be left to thicken up. A Leek with 14 in.
of blanch and $\frac{1}{2}$ in. in diameter is a much finer specimen
than one with 17 in. of blanch and only 1 in. in diameter.
Another way to plant Leeks is to draw the ordinary soil round them, placing a drain pipe vertically between each pair of plants, to facilitate feeding with liquid manure. The pipes are necessary on account of the base of the soil being broad in order to get sufficient height. In this method, boards are not required, but it is not such a good way of blanching as the one previously mentioned, and should not be adopted where boards and leaf mould can be obtained. It will be some considerable time before any feeding is necessary, but careful watch will be required to detect any falling off in the regular growth, and then liquid manure should be applied to keep the plants growing rapidly. Liquid manure from the farmyard tanks may be used, or cow manure may be put into a barrel and the barrel filled with water, stirred up, and then allowed to settle, and the liquid used. Other kinds of artificial manures are Canary Guano, Clay’s Fertilizer, Thompson’s Vine Plant and Vegetable Manure, &c. They may be used once or twice a week, in the proportion of 1 oz. to 1 gall. of water.

Leeks for exhibition must be perfect in shape, colour, &c. Care must therefore be exercised, when earthing up, not to twist or push them to one side, thus causing them to be misshapen and crooked. They must also be perfect at the bottom, not showing the slightest formation of a bulb.

**Varieties—**

- Dobbie’s International. Prize.
- Sutton’s Prize-taker.
- The Lyon.
- Musselburgh.
CELERY

Celery is another most wholesome vegetable, but as it is more or less tender it requires considerable care. When well grown it fully repays one for the trouble involved in its cultivation. It is only half-hardy.

The seeds for the main crop should, therefore, be sown towards the end of February, in a fairly rich soil, in pots or boxes. These should then be placed in a slight bottom heat, either in frames on a hotbed or in the greenhouse. Care should be taken not to sow thickly, as Celery should not be pricked off too early, and, if thickly sown, the plants will get drawn, and more or less spoiled. When the plants have formed two or three rough leaves they should be pricked out into boxes of fairly rich soil, 2 in. apart each way, after which they should again be placed in slight heat until the plants take to the new soil, when they should be gradually hardened off, care being taken never to allow the plants to become dry, or many of them may run to seed.

In the meantime, trenches should be made for the plants, the double-row trenches being considered the best, as in these the plants can be conveniently handled. They should be made 2 ft. broad, and 3 ft. allowed between the trenches. This will afford plenty of room to bank up the soil on either side, and will also provide plenty of soil for "earthing up". The soil should be taken out to a depth of from 12 to 14 in., and if the good soil does not go to a considerable depth below that, some of the subsoil should be thrown out on one side, and 4 to 6 in. of well-decayed cow manure put in, this being covered with about 6 in.
of good surface soil. Where the soil is deep enough, the manure should be spread on the bottom, and then dug in. The subsoil is worthless for growing plants in, even with the manure, but it is suitable for "earthing up".

About the middle of June the plants will be ready for planting out. They should be carefully lifted out of the frame or boxes with a hand fork, and planted with the trowel, care being taken not to plant too deeply, and so cover up the centre of the plants. Plants should be alternate with each other, and should be 1 ft. apart. A dull, showery day should be selected for this operation, and, if the weather be dry afterwards, copious supplies of water should be given, preferably in the very early morning, until the plants are thoroughly established. About the end of August they should be ready for their first "earthing up". The plants should be gone over first, all the short outside leaves and all the little suckers being cleared off. One person should then stand astride the trench and hold the plant firmly with the hands, while two others, one on each side, shovel in the soil. Then, while they break up the soil, the one who is holding the plant should firm the soil all round each plant, care being taken not to let any of it fall down between the leaves. When three men cannot be spared for "earthing up", the following is a good method. After the plants are cleared over, they should be tied at the top of the leaf stalks with matting. Then one man can put in the soil on either side, after which he can firm it down with his hands round the plants, and then cut the bindings, to ensure the centres growing up freely.

A good dressing of quicklime should be given to each
trench before breaking up the soil to "earth up". This will help to keep slugs and insects from getting into the plants and destroying them. A second "earthing up" may be done when the plants have made considerable growth, and then a final one, partly for protection, before the severe weather sets in. At this last "earthing up" the soil should be rounded away from the plants and made smooth with the back of the spade, so that the water may run off instead of down into the stems, thus causing decay. The soil should be moderately moist when "earthing up"—neither too wet nor too dry. When severe frosts set in, the Celery should be protected by placing rough litter or dried bracken over the ridges.

When Celery is wanted for exhibition, special methods of growing it are adopted. It may be raised in practically the same way as for the main crop, only it should be sown a fortnight or three weeks earlier, and a special soil of 6 parts chopped turf, 1 part leaf mould, and 1 part of well-decayed horse manure should be placed, 6 in. deep, on the top of the manure in the trench. The trench should be of the same size as that for the main crop, but a single row only should be planted, and the plants should be 12 in. apart. When the plants have made 4 to 6 in. of growth, stout brown-paper collars should be wrapped round the base—not too high, or the centre of the plant will be destroyed—for blanching purposes, instead of "earthing up". As growth proceeds, new and deeper collars should be put on, each collar going two or three times round the plant, to ensure a good blanch. When the papers are removed occasionally, search must be made to see that no slugs or insects get about the plants to
mark or destroy them. This method allows watering to be easily done, and also feeding with liquid manure when necessary. Care must be taken not to let such plants get dry, or they will run to seed. Before taking to the exhibition they must be carefully examined, to see if there are any signs of bolting—running to seed; for when they are cut down the centre this state is instantly revealed to the judges.

For insect pests, see Chapter XV.

Varieties—

Red
Major Clark’s Red. Leicester Red.

Pink
Sutton’s Superb Pink. Dobbie’s Favourite Pink.

White
Dobbie’s Invincible White. Wright’s Giant White.

LETTUCE

The first sowing of Lettuce may be made in a frame during February, and after they have made considerable growth—that is, if they have been sown thinly—they may be thinned out, and the plants planted on a warm, sheltered border, leaving enough in the frame, about 6 in. apart each way, to form a crop. The first sowing in the open should be made on a warm border early in March, in drills 1 ft. apart and 1 in. deep. Sow thinly, and, when the plants are about 3 in. high, thin out to about 6 in. apart, leaving them on the seed bed. Plant the others in drills 1 ft. apart and 6 in. between the plants. Select a dull, showery day for this operation, and if it turns
out fine and dry afterwards, water freely until thoroughly established.

The Cabbage varieties will "heart up" themselves without any assistance. Most of the Cos varieties will also turn in and form nice hearts, but if a few early ones are required, the outside leaves may be tied loosely, and this will cause the centre leaves to blanch more quickly. Successional sowings in small quantities for small gardens should be made to the end of June, as when once they are ready for cutting they very soon run to seed if not quickly gathered, especially in dry seasons.

Varieties—

**Cabbage Lettuce**

<table>
<thead>
<tr>
<th>Variety</th>
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</tr>
</thead>
<tbody>
<tr>
<td>All the Year Round</td>
<td>Tender and True</td>
</tr>
<tr>
<td>Early Paris</td>
<td>Tom Thumb</td>
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</tbody>
</table>

**Cos Lettuce**

<table>
<thead>
<tr>
<th>Variety</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leviathan</td>
<td>Paris White</td>
</tr>
<tr>
<td>London White</td>
<td>White Heart</td>
</tr>
</tbody>
</table>

**PARSLEY**

Parsley is another very important vegetable in all gardens, large or small. It succeeds well on almost any soil, yet it attains its greatest excellence on a good loamy or rather heavy soil. On light soils it will grow and produce a good crop, but it never grows in the luxuriant manner that it does on heavier soils. The soil should be well cultivated and fairly well manured.

Seed should be sown on a small border towards the end of March, in rows 15 in. apart and 1 in. deep, or it may be sown in a long line on the outside of the larger
vegetable plot, where it can be conveniently got at. When the plants are about 1 1/2 in. high they should be thinned out to 3 in. apart. A small part may be left unthinned for early picking.

Parsley for exhibition requires somewhat special treatment. This can be readily understood when we see single plants with a diameter of 2 ft.

The seed for these should be sown about the end of January, in moderately rich soil, either in pots or boxes, and placed in a gentle bottom heat. When the plants appear they should be taken out and placed near the glass. After having made the second rough leaf they should be carefully lifted and pricked out into boxes, 2 in. apart each way, in good loamy soil, with a liberal mixture of well-rotted horse manure. A better way is to pot them singly in small pots, and keep them in a gentle heat until they have taken to the new soil and commenced to grow, when they can be gradually hardened off. They may be planted out 2 1/2 feet apart each way in lines, about the beginning of May, in soil which has been trenched and well manured during the winter. If the weather is dry, copious waterings should be given at intervals to ensure steady growth, as, should the plants get a check, they are a long time recovering. If the weather is dry at the time of the exhibition, plants for show should be selected and thoroughly watered the night before. Then, in the very early morning, before the sun gets on the plants, they should be lifted and potted with as much of the soil clinging to the roots as possible. Pots large enough to hold all the roots, with the soil clinging to them, should be used, and then they should be thoroughly soaked with
water, and kept as cool as possible in the shade, to prevent any chance of collapse.

Varieties—

Dobbie's Exhibition.        Wyatt's Garnishing.
Ryder's Giant Curled.       Dunnett's Selected.

VEGETABLE MARROWS

Vegetable Marrows are deservedly popular plants in the kitchen garden, and, where the necessary amount of room required can be spared, they ought always to find a place.

In a fairly rich soil—which is absolutely necessary—they grow luxuriantly, the trailing stems growing to a considerable length.

The seeds should be sown singly in small pots about the middle of March, and placed in a frame, or on a greenhouse shelf. The pots should first be covered with glass, and then paper placed over that, to keep the seeds uniformly moist until they have germinated. After germination has taken place, paper and glass should be removed. When the plants have made some growth—but before the pots are full of roots—they should be moved into 5-in. pots and returned to the frame or greenhouse, where they should
be gradually hardened off. They should be planted out in the beginning of June, in well-trenched and well-manured soil. Many people make up an elaborate manure heap for the Vegetable Marrows, but this is not necessary; in fact, it is sometimes harmful, as when the roots get down into the manure the plants grow very strongly, and do not produce much fruit. The flowers which are produced rarely set, or frequently "damp off" after setting. Where the manure heap is properly made, with the idea of producing more bottom heat to the plants, it is very different. A trench should be thrown out, and afterwards filled with fresh horse manure and half-decayed leaves mixed together. Then the top of this should be covered over with freshly cut turf, grass side downwards, and afterwards the soil should be thrown up over the heap, which should be about 1 ft. deep on top. A hollow in the top of the heap should be left, in which the plants should be planted. Sufficient water should then be given to reach the roots of the plants. The turfs on the top will prevent the roots from getting into the manure practically the whole of the season, yet they will get the benefit of the extra heat, especially early in the season. Though helpful to the plants in producing extra heat in the soil, it is not necessary to have manure heaps at all, as the plants will grow and fruit very well on ordinary rich garden soil. They will even bear in odd corners, such as on the top of a rubbish heap, if sufficient soil is put on to give the plants a start. The decaying vegetation will supply the heat, and also the food necessary for their growth. Or, again, they may be grown on any heap of soil which may be temporarily lying about, thus covering it with
luxuriant green foliage, and also getting a crop of fruit from it.

Some people consider it necessary to pinch out the points of the shoots to induce the plants to send out laterals. This is not at all necessary. Male and female flowers grow on the same plant, and some gardeners take the trouble to pollinate the female flowers. This again is not necessary, as the bees and other insects will do all that is required.

Unless required for preserving purposes the fruit should be cut before it is too old; otherwise it is not so nice. Sometimes it is advisable to go over the plants and lay the fruit on pieces of wood, slate, &c., to keep them clean and allow them to expand uniformly.

**Varieties—**

- Moore's Cream.
- Long White.
- Large Green.
- Large Yellow.

**TOMATOES**

Tomatoes are often grown on a south aspect as an outside crop in the kitchen garden. On light soils they do very well, even in the open garden; but it is better, where possible, to give them the shelter of a wall. They also get the advantage of the extra heat when placed in such a position, for the wall absorbs the sun's heat during the day, and radiates it for a considerable time after the sun has gone down. Of course the advantage of such heat will be obvious to everyone who knows that Tomato plants require considerable heat to grow and ripen their fruit.

For Tomatoes the soil should not be too rich; if it be, very luxuriant plants are grown, to the detriment of the
fruit. A rather poor, light soil is best for out-door cultivation. It warms quickly in spring, and allows the plants to be placed out early. Afterwards, when some of the fruit has set, the plants may be assisted with artificial manure.

The seed should be sown about the end of February, in pots or boxes. Sow very thinly to prevent overcrowding. Place the pots or boxes on a shelf in the greenhouse, and cover with glass and paper until germination takes place, then remove glass and paper immediately. When the plants have made two rough leaves they should be potted into small pots, and before these are filled with roots they should be moved into 5-in. pots, and grown in a cool house.

Planting out should not take place before the beginning of June, as even a cold wind may ruin them. It is better to err on the safe side at this time of the year than to plant out a week too soon. As the weather improves, the plants will soon pull up. By this time they should be nice and sturdy, and perhaps bearing the first truss of flowers. They should be planted 18 in. apart in the rows, with from 3 to 5 ft. between the rows, and should be carefully staked as soon as planted. They should not be tied too tightly, as, when growth commences, the stems increase considerably in thickness in a short time.

When growth does begin, a sharp lookout will have to be kept for side shoots, which appear in the axils of nearly every leaf. These shoots should be picked out immediately. If left for any length of time they may practically ruin the truss of flowers below them. The growing point should also be carefully watched, and should be well supported in case of accident.
TOMATO PLANT
As the season advances, and truss after truss of flowers appear, an estimate must be formed of how much fruit the plant can ripen, and, when this quantity has grown, the growing point should be cut out, thus throwing all the strength into the branches of fruit already formed.

Defoliation should be done very sparingly. If the plants are properly grown, in soil that is not too rich to start with, it should not be necessary to cut much of the foliage away. When we consider that it is in the green leaves of plants that all the plant food is manufactured for producing new growth, and also fruit, we see at once how unscientific this practice is. But of course it is quite a different matter when the bunches of fruit begin to ripen. Leaves may then be removed so that the fruit may be exposed to the sun, which will mature the substances that were manufactured by the green leaves and are now stored up in the fruit.

Towards the end of the season, if the crop is long in ripening, those which are partially coloured may be taken off and ripened under glass, thus hastening the maturing of the fruit left on the plants. This, of course, should not be done until it is ascertained that the plant cannot mature its full crop in a natural way, as the fruit ripened under glass cannot be of such good quality as that ripened on the plant.

For diseases, see Chapter XVI.

**Varieties—**

- Lister Prolific.
- Horne's Supreme.
- Comet.
- Frogmore Selected.
- Golden Jubilee.
- Golden Perfection.
- Chiswick Peach.
- Dobbie's Golden Drop (for open air).
MUSHROOMS

This crop should not be attempted unless the proper facilities for cultivating it are at hand; otherwise disappointment and failure will be the inevitable result.

A constant and regular supply of horse manure must be available at the required times, and a large airy shed, in which to prepare and keep the manure until required for the beds, is needed. The horse manure should be brought direct from the stables each day, if possible, the droppings and short straw shaken out of it and put on the heap, while the rough straw should be taken away entirely, as being useless for Mushroom growing. When a fair quantity of manure is obtained, it should be turned over every morning, or alternate morning, to prevent the centre of the heap from overheating, as, should this take place, a considerable part of the heap may be spoiled for Mushroom culture. When turning, always be careful to turn the inside of the heap to the outside, to ensure regular fermentation of the whole heap.

When sufficient manure for a bed of the required size
The Cultivation of Vegetables

is prepared, no fresh manure should be mixed with it, but this should be constantly turned, as before, until the very rapid fermentation has ceased. This, of course, can only be thoroughly understood by practice, but even the beginner, if observant, can notice at once when the fermentation has slowed down, and is going on steadily throughout the whole heap, after which it should be left for a few days before making up the bed.

The bed should be made up according to the quantity of manure at the gardener's disposal. If only a small quantity has been obtained, it may be made up cone-shaped. If a larger supply, it may be made up into a ridge-shaped bed. The manure should be spread on in layers, and made very firm by beating and treading down, to ensure a steady heat during as long a period as possible. After the manure is thus put together, a hole should be made in the centre of the bed and a thermometer placed in it, and covered all round with manure, so that the temperature of the bed may be accurately taken. If the manure has been properly looked after, the temperature will gradually rise until it reaches its highest point, after which the temperature will gradually subside for a period of two or three months. When it has reached its highest point, and commenced to decline, it should be carefully watched until it comes down to 80° F. The bed can then be safely spawned. On no account should this be done until the temperature is diminishing, or the latter may rise too high and kill the spawn.

The best spawn should always be procured. As a rule this shows a very fine mouldy appearance. If there are thick white fibres running through it, it cannot be
relied upon, as the mycelium has been allowed to run too far before being checked. The bricks of spawn should be broken up into pieces about 2 in. square. Holes should be made in the bed about 6 in. apart each way, and the pieces of spawn inserted to a depth of 2 in., after which the beds should be covered over with \(1\frac{1}{2}\) to 2 in. of loamy soil, and beaten down. In from five to seven weeks the young Mushrooms will appear. First, a white mouldy appearance will be seen in places, and in a very short time little Mushrooms will be sent up from these patches. As soon as the beds are spawned, and covered with soil, they should be covered with straw or mats, to keep them uniformly moist. Mushrooms do best in cool weather, therefore the bulk of the crop should be taken in late spring, and then again in the autumn, making up the beds with that end in view.

Where there is a Mushroom house they can be grown at very little expense all the winter.

To utilize space, the beds can be made one above the other, one on the floor, another 3 ft. above the top of the lowest bed, and a third one 3 ft. above the top of the second one, if space will allow. The manure should be prepared as for the outside beds, and well beaten when put into the house. The latter should be kept at a temperature of 55° F., and the floor should be moistened two or three times a day.

**MUSTARD AND CRESS**

Mustard and Cress may be sown in an odd corner of the garden. The soil should be made very fine by raking, or even sifting with a fine sieve, to a depth of 1 in., as it is
only the seed leaves which are used, and these come up very quickly. For succession, seed should be sown every fortnight. When the surface soil is made fine, the seed should be sown fairly thick and pressed slightly in with the rake. As birds are very fond of these seeds, the beds will require to be covered with a piece of net, or otherwise protected until the plants are well up. They should be cut when young. The surface soil should then be renewed and a fresh sowing made.

**ARTICHOKEs**

Jerusalem and Globe Artichokes are two vegetables which are not very common in the garden, because they take up a considerable amount of room, and are not as a rule generally liked as food.

Jerusalem Artichokes may be planted like potatoes, in well-worked soil, in rows 2½ ft. apart, with 1 ft. between the tubers; but in small gardens they should be planted in a single row. This row is very convenient as a screen, where one is necessary, to protect the rest of the garden. Artichokes should not be lifted too early, and can be left in the ground well into the winter.

Globe Artichokes may be raised from seed sown in the spring, afterwards being planted 4 ft. apart each way, where they will form nice clumps. They should be mulched in winter with rough manure.

**SEAKALE**

Seakale is another vegetable which is not so frequently met with as it might be.

Seed should be sown in early spring, in rows 12 in.
apart and 1½ to 2 in. deep. Sow seeds thinly, and when large enough the young plants should be planted in rows 2 ft. apart, with 1 ft. between the plants in the rows. They will form nice crowns by the third season, when they may be taken up in the autumn after the leaves have died down. All the branch roots should be cut off, and the pieces from 3 to 6 in. long, and as thick as a lead pencil, should be preserved, cut straight through at the upper end horizontally, and sloping at the lower end. These may be kept in sand until the spring, when they should be planted out in rows 1 ft. apart, with 18 in. between the plants, the top being level with the ground. If the soil is very good, they will form good crowns by the autumn. The old crowns may be forced inside by placing round large flower pots filled with ordinary soil and putting them in heat in a dark place—a corner of the Mushroom house is suitable. They may also be planted in the open garden in clumps, and covered with boxes or small barrels and afterwards with rough manure, when the crowns will produce a fine crop of stout blanched leaf stalks.
HORSEFADISH

Horseradish is indispensable in gardens of any size. It may be propagated as advised for Seakale by procuring pieces of root about 6 in. long, cutting straight through at the top and slanting at the bottom, and planting in spring in an odd corner in rows 1 ft. apart, with 6 in. between the pieces. It will soon form a plantation. As the roots are taken up, the tops may be cut off and planted where they were dug from. They will then form nice roots suitable for cutting.

KOHLRABI

This is another vegetable which is not very frequently met with. It is more or less like the Turnip, but stronger in flavour, and by many people disliked. It may be treated in exactly the same way as the Turnip.

SALSIFY

Salsify is another rare vegetable, and, where variety is wanted, should find a place in the garden. It should be sown in drills 1 ft. apart and 1½ in. deep in April. When large enough, it should be thinned out to 6 in.
apart. It may be lifted in October and stored in sand until required.

**SCORZONERA**

This may be treated in the same way as Salsify. The two are frequently grown side by side.

**SPINACH**

Spinach is very frequently grown, and finds a place in all large gardens. The first sowing may be made in February, and should be made in rows 18 in. apart and 2 in. deep. Successional sowings may be made as required at intervals until the beginning of September. The latter date is the time for sowing the prickly-seeded or winter varieties, which are hardy.

**SHALLOTS**

Shallots are very common in small gardens, and deservedly so. The small bulbs may be planted in rows 1 ft. apart, with 6 in. between them in the rows. They should be buried in the soil, only the neck appearing above it. In a short time they will begin to grow, forming clusters of small buds and nice young leaves which can be used like spring onions. Those not required for use may be allowed to ripen, and then taken up and dried, as onions are, for planting the following season or for use.

**HERBS**

Herbs are more or less neglected. When they are included in the garden they are very often put into some corner, apparently to be out of the way. Now for such
useful and interesting plants this should not be the case. They should be given a good, if not prominent, place in the garden.

Most of the herbs can be grown from seed sown in the ordinary way in drills from 15 to 18 in. apart, to give plenty of room to keep them clean and to allow gathering without causing any damage. The following may be sown in this manner:

Angelica, Balm, Basil (sweet), Borage, Burnet, Chervil, Chives, Coriander, Dill, Fennel, Horehound, Hyssop, Lavender, Mallow, Pot Marigold, Sweet Marjoram, Mint, Parsley, Pennyroyal, Purslane, Rampion, Rosemary, Rue, Sage, Summer and Winter Savory, Skirret, Sorrel, Tarragon, Thyme, and Wormwood.

Some of these, such as Lavender, Mint, Sage, and Thyme, may be propagated easily from cuttings. Owing
to the nature of the running roots of mint, this herb should be taken up occasionally and replanted, as it is difficult to keep the ground clean unless this be done. At the same time it will benefit the plants.

Most of the herbs are best if they can be used in a green state, but many also do very well if cut, dried, and then kept in wide-mouthed bottles. If these are kept well corked the herbs can be kept for some considerable time. Horehound and Mint should be cut on a dry day in summer, just when the flowers have fully opened, and dried slowly in a cool shed. They must on no account be exposed to the sun or the heat of the fire while drying. When dried, the leaves should be rubbed off and placed in bottles, which should be tightly corked. Parsley, of course, has been treated by itself, and can be obtained in a green state all the year round. Where the climate is severe the Parsley bed may be boarded round and covered with a frame or with some branches.

CHAPTER VI

The Cultivation of Fruits

The cultivation of fruit does not appear to be understood as well as its importance deserves, or growers might make considerably more out of their orchards than they now do. One often hears that growers have large crops but cannot get buyers. Why is this? Simply because quantity is not by any means the principal point. The writer is thoroughly convinced that a regular supply of
A WELL-CROPPED ALLOTMENT
fruit of the highest quality would always command its own price. Think of the hundreds of tons of fruit which are imported into this country each year and which cannot be compared in quality to British-grown fruit.

How are we to get a regular supply of fruit of the highest quality? Only by a thorough system of cultivation.

THE STRAWBERRY

Speaking generally, the Strawberry will grow on almost any well-cultivated soil. Certain varieties will grow and produce better crops on rather heavy soils; others, again, will produce finer crops on a lighter soil.

The soil should be thoroughly trenched and well manured before the plants are put in, as it is not convenient to manure well after planting has taken place. This should be done after the early crop has been taken off during August. Young plants should be procured as early as possible in September, and planted so as to get them well established before winter. They may be planted in rows $2\frac{1}{2}$ ft. apart, with 18 in. between the plants in the row. Care must be taken not to cover the crown of the plants. The roots should be put in as deep as possible, but the base of the crown should be level with the soil.

Another method is to put the plants in clumps of three, the clumps being $2\frac{1}{2}$ ft. apart, with 3 ft. between the rows. This method of planting allows the fruit to develop thoroughly all round the clumps. It also allows plenty of room for it to be gathered.

The method often adopted by market gardeners is
to plant three rows, 15 in. apart, with the plants 15 in. apart in the rows; a path 3 ft. broad is then left, then another three rows of plants, another path, and so on. In this way the runners are not taken off between the rows, and no bedding is required. It saves a great amount of labour when Strawberries are grown on a large scale, but the fruit can never be of a high order of excellence, and this plan therefore should never be followed unless the fruit is cultivated very extensively.

Where fruit of the highest quality is required, one of the first two methods should be adopted. If the planting has been done in August or September, the plants should be well established before winter, and should produce a fair crop the following season. By the time the flowers have begun to open, the ground should be thoroughly bedded over, preferably with clean straw, care being taken to lift up the trusses of flowers and to put plenty of straw under them to ensure the fruit being kept perfectly clean. Grass that has been dried is sometimes used for this purpose, but care must be taken that the grass is not too far advanced before cutting, or much trouble may ensue the following year from the germination of the seeds that have fallen from the ripened grass. The short grass from lawns is also used. This answers very well in dry seasons, but should the weather be wet the grass does not dry satisfactorily, and the dampness causes it to decay. In such seasons, also, the fruit is softer, and if lying on decaying matter it also begins to decay, and so considerable quantities may be lost. It will be seen that clean straw, although more expensive to begin with, may be more economical in the end.
In gardens where small quantities are grown, the fruit must be protected from birds, and it is better to net the beds over before the fruit begins to colour. If the birds once get a taste of the fruit they are most troublesome, and if by any chance there should be a hole in the netting the birds will find it in their endeavours to obtain the fruit. The best way to put the net on is to put posts from 2 to 4 ft. high, and run stout cords from one to the other, after which the nets may be spread over the top and dropped down at the sides. This will allow the net to be slipped off conveniently where the posts are only 2 ft. high; but where they are 4 ft. high, a person can, by stooping, get right under without removing any more of the net than is necessary.

When taking strawberries for the table they should be picked with the calyx attached, and care should be taken to see that they are fully ripe. It often happens that in fine sunny weather the fruit will ripen on the side towards the sun, but the other side will be quite unripe. The fruit should be examined all round before it is picked. If it is to be packed for travelling before being used for the table, or for exhibition purposes, a quantity of leaves should be picked with it, and each fruit should be placed in one of the leaflets; the whole being packed firmly, layer upon layer, until the box is full. In this way, with ordinary care, it should travel without damage. When picking for jam, the fruit should be picked without the calyx, thus saving time afterwards. It should be packed in baskets, with not more than 7 lb. in each, to prevent that which is underneath from being smashed.

The Strawberry plantation should be renewed every
third, or, at the most, every fourth, year. It is impossible to cultivate the ground thoroughly between the plants, therefore both plants and fruit gradually deteriorate. Manure may be applied as a topdressing in early winter, and this may be pointed in during February.

When a new plantation is to be made, the young plants should be carefully looked after. This is best done by filling sufficient small pots with loamy soil, and wherever a nice runner is found the bud at its apex should be pegged down into the pot, when it will soon send out roots which will gradually fill the pot. By this time the plants will be of a fair size, and the runner may be cut close to the young plant and the latter removed from the ground. Care must of course be taken to keep the young plants watered during dry weather. If the soil is fairly good, the runners may be left to root themselves and the best plants lifted when ready for planting.

Strawberries are also grown extensively under glass in early spring, and if this be done with only a little artificial heat they will be ready about a month before the outdoor crop. They must be rooted in small pots, as explained above, and as soon as well rooted they should be potted into 6-in. pots, thus allowing room for strong plants to be formed for fruiting the following spring. The soil for potting them should be made up of four parts chopped loam, one part leaf soil, and half part well-rotted horse manure, with enough sand to keep it open, and two 6-in. potfuls of wood ashes to a barrowload of the mixture. When potted, they should be placed in a cold frame, or where the heavy rains can be kept from them. In spring they may be taken under glass in batches as required, and
placed on shelves near the glass. Care must be taken to give plenty of water when growth has commenced, and they should also be syringed frequently to keep down Red Spider. If turfs are placed on the shelves, grass side downwards, and the pots placed on these, there is less chance of the plants suffering from drought. As the fruit ripens, rather less water will be required, but on no account must the plants get dry.

Varieties—

| British Queen. | Royal Sovereign. |
| Kentish Favourite. | Sir Joseph Paxton. |
| Latest of All. | Trafalgar. |
| Vicomtesse Hericart de Thury. |

THE RASPBERRY

This is a fruit which is more or less neglected in many gardens. As it is a useful plant, this should not be the case.

A shady place is most suitable for this fruit, and a rather heavy soil suits it best. The soil should be thoroughly dug or trenched and manured. The young plants may be planted either in the early winter or during February, and the canes should, in the early spring, be cut back to within 4 to 6 in. of the soil to ensure the young plants sending up fairly strong canes which will fruit the following season. It is worse than useless to look for any crop from the young plants the first season, and if the canes are not cut down they will break out and attempt to fruit, taking a large quantity of the strength of the plant, which will, in consequence, only send up weak canes, producing little or no fruit the following season.
The best method of growing the Raspberry cane is on a wire fence. Strong posts should be driven into the ground 12 ft. apart, and two wires stretched from post to post, the first one being 2 ft. from the ground; while the second may, on heavy soils, be 4 or 5 ft. high. The canes should be tied to these, and cut over in late spring, after the danger of frost is past. They will afterwards break out at each eye, forming nice young shoots, which will bear fruit the same season. After fruited, the canes die down, the plant in the meantime producing young canes which will take the place of the old ones, and fruit the following season.

As birds are very fond of the fruit, the canes must be netted early. The best way to do this is to have strong pieces of wood nailed together in the form of a T. These should be fastened to the posts well above the top of the canes, with the cross piece at right angles to the line of canes. Strong cords should then be stretched from one cross piece to the other, the cross piece being not less than 4 ft. long. The net should be laid along the centre line of the cross piece, and afterwards dropped down on either side. As soon as all the fruit is picked, the net should be removed, and the young canes tied loosely in until the old canes ripen off, when they should be cut out entirely, and the young canes tied in more tightly, until there is time to get them permanently fastened to the wires.

During the winter a thorough topdressing of vegetable
refuse and leaf mould, 4 in. thick and 2 ft. on either side of the plants, should be given. Another method of growing Raspberries is to plant two young canes against a stout post, previously driven into the ground, and to tie the young canes round the post. Such pillars may be 6 ft. apart one way and 4 ft. the other. The canes may be treated in the same method as advised for fence training.

The market gardener, however, has not the time to devote to the canes that the amateur has. His method is to plant the canes in rows about 4 ft. apart and 4 ft. between the plants. He then takes two or three canes from one plant, and two or three from the next one, bending them so as to overlap each other, and thus to form small arches. The young fruiting branches spring from the canes on the upper side, and are thus held in position. At other times, the canes are cut well back to within 2 ft. of the ground, in spring, thus enabling them to support branches with fruit without any assistance. Of course, neither of these latter methods will produce fruit of such good quality, nor in such quantities, as those previously mentioned.

Varieties—
The Black Currant is also an important fruit in the garden, and should be carefully looked after. It succeeds best on a rather heavy soil, though it grows and fruits fairly well on almost any good garden soil.

When procuring young bushes it is advisable to get them without main stems, but rather stool-like in appearance. From the nature of their growth, if grown on the main-stem system, they are apt to break down with the weight of fruit and leaves, especially during a heavy storm. When the cuttings are made of nicely ripened wood about 1 ft. long, the buds should not be rubbed off much under the soil. They will then throw up suckers which will form the stool-like bush. The bushes may be planted 7 ft. apart each way, on ground which has been thoroughly dug or

Winter Pruning of Black Currants
trenched, and manured. The pruning for the first few years will consist in cutting out all weak shoots, and thinning out the others, to ensure light and air getting into the bush to ripen the wood thoroughly. As time goes on it will be found necessary to cut back some of the older branches, to keep the bushes within bounds. It will be noticed that here and there, on the old branches, young shoots are thrown out. The old branches should be cut back to one of these young shoots, which will grow and take its place. This should be done at every pruning; the bushes will then always be kept in good fruiting condition. If carelessly managed for a few years a season or two of fruiting may be lost in getting the bushes back into proper condition again.

As the fruit is generally produced on the previous year's wood, on no account should the shoots which are left be cut back.

Like all other crops, if the bushes are to be kept in good fruiting condition, the soil must be supplied with food to make up for what the crop of fruit, &c., takes out of it each season. A topdressing of vegetable mould—the well-rotted refuse from the kitchen garden—has been found to be very efficient for this purpose, if forked lightly into the soil; failing this, well-rotted farmyard manure will answer the same purpose.

It is not so necessary to protect this fruit, as birds do not seem to be particularly fond of it, if there is anything else to be obtained. There is, however, a terrible scourge to be contended against in the Black Currant Mite, which has caused tremendous havoc in the Black Currant plantations.
The Black Currant is a very profitable crop, and fully repays one for the small amount of work necessary in its cultivation.

Varieties—

Baldwin. Naples.
Boskoop Giant. Defender.
Goliath. Victoria.

RED AND WHITE CURRANTS

Red and White Currants are generally propagated by cuttings from 10 to 12 in. long of well-ripened wood. In this case all the buds should be rubbed out with the exception of four, as the bushes are grown with a main stem. The young bushes will be ready for planting out into their permanent quarters in the second or third year, when they should be hardy little bushes with from six to twelve shoots, which will form the foundation of the future bush. They may be planted from 5 to 6 ft. apart on well-cultivated and manured soil. A good loamy soil is best for currants, but fair crops may be obtained on almost any soil. On light soil they will generally benefit from a good mulching of rough manure, with copious supplies of manure water in dry, hot weather.

Red and White Currants fruit on spurs as well as on the young wood, so that in pruning the knife may be used more freely without risk of reducing the crop. The main branches should be run up, and the laterals cut close back, laying in a new branch wherever required as the branches grow and widen out at the top. After the bushes have filled the spaces allotted to them, the pruning will consist in “cutting back” all the shoots forming spurs, which will
The Cultivation of Fruits

continue to produce fruit in large quantities. Care must be taken not to overcrowd the main branches, so that the light and air may have free access throughout the bushes to ripen the wood as well as the fruit. A sharp lookout must be kept for any of the main branches showing decay. When this happens a young one should be laid in immediately to take the place of the decaying one. Summer pruning should be practised to reduce the number of young shoots, and to enable the bush to get plenty of light and air.

Red and White Currants may be trained as espaliers, or on walls, where they may be planted 3 ft. apart, and the branches spread out to fill up the space, the main branches only being led out, and the laterals cut hard back to form spurs. The leaders should be cut back each year to 9 or 12 inches, to ensure the branches being well studded with fruiting spurs. When the branches have reached the desired height, they may be kept cut close back each year.

By growing these useful fruits in different positions in the garden, the time of their fruiting may be considerably prolonged. For instance, those growing on a south aspect
or wall will fruit much earlier than those on a north aspect or wall.

When the fruiting season arrives, care will have to be taken to net these fruits, as the birds are very fond of them. A watch will also have to be kept for insect pests, a description of which will be given in Chapter XV.

Varieties—

Red
Fay’s Prolific. Ruby Castle.

White
White Dutch. White Grape.

THE GOOSEBERRY

The Gooseberry is generally propagated by means of cuttings. Nice medium shoots should be selected, and the centre part, from 10 to 12 in. long, used as the cutting. This should be inserted in sandy soil in spring. The buds should be rubbed out, all but the three at the top. These three buds will form the first shoots of the bush the same year, and should form three nice strong shoots. These should be cut well back, and not more than two shoots should be allowed to grow from each. At the end of the second year, if the cuttings have been well grown, they may be planted out into their permanent quarters 7 to 9 ft. apart each way in well-cultivated and manured soil. The soil between the bushes may be utilized for growing other crops until the bushes fill up these spaces. Any ordinary garden soil will grow fairly good Gooseberries, but the best results are obtained from a good, rich, and moist loam.
Neither a very light nor a very heavy soil is well suited for the cultivation of this bush. The roots like to ramify freely in the soil. The Gooseberry succeeds best in the North of England and in Scotland, where the summer is not so hot during the period of ripening.

Care should be taken not to plant the bushes too deeply, and, when once they are established, a liberal supply of well-rotted farmyard manure should be given each year, forking it in lightly round the bushes. The Gooseberry bears its fruit on spurs as well as on the young wood. Therefore a combination of the two systems of pruning—spur and extension—should be adopted. Care must be taken not to start the extension system too early, or the bushes may be spoilt. Young shoots on young bushes should be cut fairly well back to get the main branches of the bushes strong, and thus able to support the smaller branches, which will be laden with fruit. If this be not done, the branches will be weak, and, when laden with fruit, will bend over and spoil the bush. The fruit also, if not actually lying on the ground, will get splashed with sand during heavy rains, thus spoiling it to a great extent. When the main branches have grown strong, by being cut back each season for several years, the extension system may be gradually adopted. The shoots may be left longer and longer, until they have practically attained their full length. Then, in favourable seasons, if careful manuring has been done, each bud from the base to the apex will produce fruit. When pruning is required, the first thing to do is to look over the bush for any dead branches, afterwards cutting out all cross shoots, and all weak, worthless ones. Then the bush should be carefully
Gone over, thinning out all the young shoots which are not required, to prevent overcrowding and to allow the light and air to have free access throughout the bush. This allows both fruit and wood to be properly ripened the next season. The shoots should be cut well back to induce fruit spurs to form. If they are left about 1 in. in length, they will produce a cluster of weak, worthless shoots, and no fruit.

The Gooseberry may also be trained on walls and as espaliers, especially in the north. In the south it is generally too hot for them in summer to succeed well as wall or espalier fruits. Where they do succeed in this form, the season for this fruit can be considerably prolonged by

Gooseberries grown on a Wire Trellis
The Cultivation of Fruits

growing in a southern aspect for the early fruits, and in a northern aspect for the later ones. The bushes may be planted against the fence for espaliers, or against the wall for wall bushes. The shoots may either be spread out fan shaped, or two shoots only may be used to begin with, and run out horizontally, one on each side of the bush. The young shoots, at intervals of about 6 in., should be led vertically. The lateral shoots should be cut away, thus forming fruit spurs. The leaders should be cut back from a quarter to half their length, according to their strength, to ensure the regular formation of fruit spurs over the whole of the branches.

An account of the insects and diseases which attack the Gooseberry will be found in Chapter XV.

Varieties—

<table>
<thead>
<tr>
<th>Red</th>
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<th>Green</th>
<th>White</th>
</tr>
</thead>
<tbody>
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<td>Broom Girl</td>
<td>Greengage</td>
<td>Early White</td>
</tr>
<tr>
<td>May Duke</td>
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**THE CHERRY**

A good loamy soil is best suited for Cherries. They do not succeed well either in light or heavy soils. The soil should also be well drained.
There are two distinct kinds. These require entirely
different treatment.

1. Those suited for dessert.
2. Those suited for cooking.

They may be propagated by budding or grafting, and may be grown either as bush, standard, or wall trees. The Morello Cherries fruit on the previous year's wood, therefore this will only have to be thinned out at pruning time, whereas the dessert varieties fruit almost entirely on spurs, therefore practically the whole of the young shoots may be cut off, except the leading ones, until they have filled the space allotted to them. If grown as bush or standard trees, the shoots should be cut off to prevent overcrowding. In the case of Morello Cherries, they should be stopped back also, if required to keep the tree in shape. Summer pruning should also be done to allow the light and air to get in to ripen the wood for next year's fruiting. The dessert cherries, if grown as bush or standard trees, will only require the shoots to be thinned out, and the young wood which is not required as leading shoots should be cut right away, and any branches which tend to run away and spoil the symmetry of the tree stopped back.

When grown on walls, the fan system of training is most suitable for the Morello, as the shoots can be more easily "cut out" and "laid in" as necessary for this kind of growth. During summer the young wood should be cut out, with the exception of the shoots required for "laying in", and of the leaders, which may be "tied in" at the same time. The "nailing" or "tying in" should be done during winter. If left too late the buds are apt to be knocked off when they have commenced swelling.
The Cultivation of Fruits

The dessert varieties may be trained either on the fan system or horizontally, as when once the branches have made their growth they do not require to be replaced by young growths. All the young wood may be cut off at the summer pruning, except the leading shoots, and these only will require "nailing" or "tying in" during winter. Care should be taken not to allow the nails to come into contact with the branches, or serious injury may be done. The old ties on the older branches should be looked over to make sure that none are too tight, and thus liable to strangle the branch. Birds are very fond of cherries, therefore, as soon as the fruit begins to colour it should be carefully netted, putting a framework over the bush trees, keeping the net off the walls with stakes in the case of those grown on a wall. If they are well netted, the Morello cherries may hang on the trees until late in the season.

Cherry trees flower very early in the spring, and may sometimes be injured by frost. This may be prevented by spreading a double net, or other light material, on a framework over the trees on the appearance of frost. This protection must be taken off in the morning, when the frost has gone, as heavy shade will be injurious to the blossom.

Insect pests will be dealt with in Chapter XV.

Varieties—

*Yellow*  
Bigarreau  
Bigarreau Napoleon  

*Black*  
Black Eagle  
Corone  

Elton  
Governor Wood.  
Early Rivers  
Guiane Annouay
THE PEACH

The Peach is cultivated to a considerable extent, though it is rather tender, and requires the protection of a glass house, or at least of a wall with a southern aspect. In the latter position, however, the Peach is very successfully grown in this country. It succeeds best in a good loamy soil, which should be well drained. It is generally trained on the fan system. Fruits are formed on the young wood, thus necessitating the "laying in" of plenty of young fruiting wood, and of the "cutting out" of some of the older wood which is past fruiting.

During the spring, when growth has commenced, disbudding should take place, thus throwing all the strength into the shoots which are required, and into the fruit. It will also allow the light and air to get in to ripen the fruit, and also the wood for next season's fruiting. All the young shoots which are growing straight out, and many of those from the under side of the branches, as well as some from the upper side, may be rubbed off. Some protection is often necessary during the period of flowering, as injury may be done by spring frosts. A sharp lookout must be kept during this season, and screens should be kept at hand which can easily be fixed in the event of frost appearing. They must, however, be taken down as soon as the frost disappears in the morning.
If there be a heavy set of fruit, it should be thinned out, as it is always better to have a smaller quantity of good fruit than an abundance of that which is of inferior quality. One fruit to every square foot of the tree is considered a satisfactory crop.

As time goes on, the thinning of the shoots may be necessary, to allow both wood and fruit to ripen properly, those not needed being cut back to within 2 in. of the base, and the others “tied in”. When the fruit begins to ripen, a net may be fixed at the bottom of the tree and spread out to catch any that may fall, thus preventing bruising. In dry seasons a mulching of rough manure may be laid round the trees, and copious supplies of water given at intervals, as the border for growing Peaches must be well drained, and they will consequently suffer readily from drought.

Varieties—

<table>
<thead>
<tr>
<th>Dr. Hogg</th>
<th>Hales's Early</th>
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</thead>
<tbody>
<tr>
<td>Early Rivers</td>
<td>Royal George</td>
</tr>
<tr>
<td>Gladstone</td>
<td>Stirling Castle</td>
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</table>

THE APRICOT

The Apricot is not so often met with in our gardens as it might be. Its culture is not thoroughly understood. It should be planted in a good, deep, loamy soil which is well drained. It should be planted against a wall, where the extra heat will be found beneficial in ripening the fruit, and also the wood for the following season’s fruiting. It succeeds best when planted on a south-western or western wall, and should be trained on the fan system. The tree comes into blossom early in the spring, and careful watch
must be kept to screen it from the frost. A good mulching of rough manure should be given before the hot weather sets in, and thorough waterings of manure and rainwater given at intervals, until the fruit has ripened, when, unless the weather be very hot and dry, the watering may be discontinued. As the fruit begins to ripen, the superfluous young shoots should be cut back, and those that are ripened should be tied in, thus exposing the fruit to the sun. It has also been found beneficial to give a good mulch of rough manure during winter, to protect the roots from severe frosts.

The fruit is excellent, and is worthy of being more widely cultivated than it is at present. There are many bare walls which might profitably be covered with Apricot trees, and if attention is paid to the simple details given here, a large quantity of this fruit could easily be produced.

\textit{Varieties—}

\begin{tabular}{ll}
Breda & Orange \\
Hemskirk & Royal \\
Moorpark & Turkey
\end{tabular}

\textbf{THE PLUM}

The Plum is very extensively grown, and its cultivation seems to be fairly well understood. The trees are generally raised by budding or grafting, and may be planted as bushes, standard, or wall trees. If the time can be spared, maiden trees should be procured, when they can be shaped as desired. If bush trees are required, the stem may be cut down to within 12 in. of the base, and not more than three shoots allowed to grow up, which should be trained outwards to form the principal branches of the
FAN-TRAINED APRICOT TREE ON SOUTH WALL
The Cultivation of Fruits

tree. These, at the end of the following season, should be well cut back again, and two shoots from each allowed to grow up. These should form the foundation of the tree. As the Plum bears its fruit on the young wood as well as on spurs, the future pruning will consist in thinning out weak, worthless shoots, and "laying in" young wood where it can be conveniently done; care, however, should always be taken not to allow the tree to become overcrowded—a thing which is very often done in the case of Plum trees. The light and air must get right through the tree, or the wood will not ripen, and thus produce good crops of fruit the following season. Therefore the aim of all pruning should be to open up the tree, and allow the wood to be thoroughly ripened each year. This is especially necessary 

Plum—Coe's Golden Drop
in the case of the Plum, where some of the young wood has to be left for fruiting. When nice young fruiting shoots can be left, some of the older branches may be cut out to make room for them.

In some favourable seasons the weight of fruit is so great that the trees would be destroyed if left unattended. The fruit should be thinned out so as not unduly to exhaust the tree, and the branches should be propped up, for if allowed to hang down, owing to the weight of fruit, they will not go back to their original position when the fruit has been picked.

Practically the same rules apply to standards, though the trees are higher. The ground under these can be more easily worked, and bush fruit may be grown between them.

On walls, the Plum is generally grown on the fan system of training. The nature of its growth lends itself especially to this system. Starting with the maiden tree again, the main shoot should be cut down to within 8 or 9 in. of the base, and three shoots only allowed to grow. These in turn should be cut well back the following season, and two shoots only allowed to grow from each. This should form the foundation of the tree. The future pruning and training will consist in cutting out all weak and unnecessary shoots, and “laying in” strong ones at regular intervals, spreading out the main branches, and “laying in” the young ones between as growth goes on. On no account should the bottom branches be taken down too early into the horizontal position, or they will not grow so rapidly as the more upright ones, and consequently the appearance of the tree will be spoiled. They should even
be crossed over the others for a few years, until they have made good strong branches, when they can be taken down into the horizontal position by degrees. Again, care must be taken not to overcrowd the branches. Six inches apart will be close enough for the wood and fruit to mature properly. As the trees grow older, and the main branches become bare, a young fruiting shoot may be tied on the top of the branch, thus ensuring the whole of the tree being covered with fruiting wood. On no account should more than one be "laid on" in this manner. When it has borne its fruit it may be cut out, and another laid in its place.

If Plums are planted on a south or early wall they flower early and may be injured by spring frosts. It is therefore advisable to have screens which can conveniently be attached to the wall, but at some little distance from it, so as not to injure the blossom. These screens should be removed as soon as the frost is gone in the morning.

The fruit must be protected from birds, and in some seasons from wasps also. A description of insect pests and diseases will be found in later chapters.

**Varieties—**

**Dessert**

Coe's Golden Drop, yellow.
Greengage, green.
Kirk's Purple.
Reine Claude de Bavay, green.
Transparent Gage, greenish yellow.
Victoria, red.

**Kitchen Use**

Cox's Emperor, dark red.
Diamond, purple.

Magnum Bonum, white.
Prince of Wales, purple.
THE PEAR

The Pear is grown in most gardens, and is easy of cultivation. It succeeds moderately well on almost any fairly good garden soil, though a deep, good, loamy soil is best suited for its growth. It does not succeed well on a heavy clay, unless the soil has been well drained and improved by trenching, &c.

It is generally propagated by budding or grafting, and may be grown as bush, standard, pyramid, or wall trees. The finest fruits are naturally to be looked for from wall trees, where the border has been well prepared for them, and where the wood can be thoroughly ripened by plenty of sunshine, and the extra heat absorbed and given out again by the wall.

The Pear fruits entirely on spurs which are formed on wood a year or more old. The formation of these spurs should therefore be encouraged.

Starting with the maiden tree, the main shoot should be cut back to 8 or 10 in. from its base, and three shoots allowed to grow up. The following year these should be cut down to within 6 or 8 in. of their base, and two shoots trained upwards. This should form the foundation of the bush tree. The future pruning will consist in cutting out all weak and unnecessary shoots, and leaving new leaders as the tree grows and spreads outwards.

For pyramids, the young shoot should be again cut
down, and four shoots should be allowed to grow up. At the next pruning time the leader should be left twice the length of the others, while the other three will form the first series of branches. The leader should again be encouraged to form four more shoots, and so on. The laterals should form one or two shoots, as the strength of the tree will allow. As the tree gets older, care will have to be taken not to permit it to become overcrowded with branches or shoots.

For standards, the head may be formed on the lines suggested for bush trees.

Pears may be grown on walls, as cordons, obliquely, fan-shaped, or horizontal. Whichever system is adopted, care must be taken not to overcrowd the branches. The oblique system consists in having a central stem with the branches running obliquely away from it, widening out
the farther they get from the main stem, and other branches laid in to fill the wider spaces towards the outside.

The horizontal system consists in having a central stem with the branches running horizontally away from it. When well done, this system looks very attractive. Great care must be exercised in selecting the branches. These should be healthy and vigorous, because, if one fails after it has been started, it may spoil the appearance of the tree for years or even permanently. The branches should be as nearly as possible 12 in. apart, and the two lower ones should be kept in an oblique position for a few years, until they are quite strong, when they may be gradually taken down.

The Pear is often grown as cordons, and good crops of the finest quality are often obtained from such trees. The only care necessary for cordons is to see that they are well studded with fruit spurs from base to apex. To do this it is necessary to cut the whole shoot back, to make sure that plenty of spurs will be formed. The spurs themselves will occasionally require pruning, and this should not be neglected, as nothing looks worse than to see long, straggling spurs, 1 ft. to 18 in. in length, growing out from small trees. This can be avoided by a judicious use of the knife at pruning time, in cutting off those spurs that show a tendency to run away. One need not be afraid of cutting off a fruit bud here and there, as it only helps to strengthen those that are left.

A great many pears do not ripen on the tree, and only mature when kept in the fruit room. Again, some will keep for months when stored, while others soon decay,
The Cultivation of Fruits

Some varieties are very luscious, and suitable for dessert. Others are only suitable for cooking.

**Varieties—**

*Early*
- Beacon.
- Jargonelle.
- Clapps's Favourite.
- William's Bon Chretien.

*Mid Season*
- Beurre d'Amanlis.
- Beurre Superfine.
- Pitmastor Duchesse.
- Louise Bonne of Jersey.
- Marie Louise.
- Conference.

*Late*
- Easter Beurre.
- Durandean.
- Beurre Clairgeau.
- Winter Nelis.
- Passe Colmar.
- Chaumontel.

**THE APPLE**

The apple is one of the most common fruits in our gardens, and owing to its usefulness it well deserves to be extensively grown. When the simple points in its cultivation are understood and attended to there is nothing to hinder anyone from growing Apples successfully.

This fruit will succeed on almost any soil, though it attains its greatest excellence on a good, deep, and well-cultivated loamy soil. It is generally propagated by grafting or budding, and in some nurseries is grown in very large quantities. It is generally grown as bush trees in small gardens, and as standards or bush trees in large orchards, but it may also be grown as espaliers, or on walls, and as cordons.

When planting, the Apple tree, in common with all other trees or bushes, should have the roots carefully dressed.
In lifting trees, no matter how carefully one goes to work, some of the roots are broken. If trees are planted with these broken roots, the latter in all probability decay, and in time the main root becomes affected. This causes the tree to die. If such trees are lifted and examined, it will be found that the trouble has originated at the broken part of the root.

Trees should be thoroughly examined before planting,
and all damaged roots should be cut off with a clean, sharp knife, making the cut in a slanting direction—upwards, so that when the tree is placed in the hole for planting, none of the cut surfaces are visible. The water will then drain away from these cut surfaces, and allow them to heal quickly. If the cut surface faces upwards, the water settles in the wood vessels and prevents the wound healing quickly. When the roots have been dressed, the hole should be dug for the tree, care being taken that the roots can be spread out straight all round. The roots of the tree are the collectors, and also the channels through which the moisture with food substances in it passes up into the leaves. If such channels are stopped by being doubled up, the tree must suffer. The hole must not be too deep, for it must be remembered that most of the food is in the surface soil, and that not only is there a scarcity of food in the subsoil, but there are other substances in it which are injurious to plant roots, until it has been exposed to the atmosphere and tilled for some time. The hole having been made, and the roots well spread, the soil used to cover the roots should be broken up very fine, to allow it to get well in amongst the root fibres. When once the soil is put in, the tree should not be moved; otherwise the roots are sure to get doubled up. When the roots are covered over, the rougher soil may be put in, and when the hole is half-filled, the soil should be firmed in with the feet, afterwards filling up the hole, and then firming again to prevent the wind from shaking the tree, and also to give the roots a good hold of the soil. If the trees are large, they may, for a time, require a stake to prevent them being loosened or blown over.
Trees should never be planted when the soil is wet. The best time for planting is as soon as possible after all the leaves have fallen in the autumn. They will then have time to heal, and take hold of the soil, before growth commences in spring.

The Apple bears its fruit on spurs, so that practically the same details of pruning, &c., will suit it as advised for the Pear.

The distance apart for large orchard trees may be from 24 to 36 ft., according to the varieties—whether strong-growing or otherwise. Pyramids may be planted from 9 to 15 ft. apart, while cordons may be planted from 18 in. to 2 ft. apart. The horizontal cordons, which are perhaps more ornamental than useful, may be planted from 6 to 10 ft. apart. If the latter are planted round rose beds or other ornamental corners, with the stem about 2 ft. high, and a branch growing out from each side, along a wire or wooden rail, they look very effective when in flower, and also again when the fruit is ripening. They must be kept closely pruned, and summer pruning must be done early. The buds must even be pinched again, if necessary.

Fruit trees, like all other trees, require manuring to keep them healthy and in good fruiting condition, but care must be taken not to overmanure them, or they will produce a quantity of rank wood and very little fruit, especially when nitrogenous manures are used.

For trees which are below the standard of vigour a good mulching of cow manure in spring, with occasional thorough waterings with liquid manure during the season, will be beneficial. All fruit trees benefit by an application
of 2 to 3 parts of superphosphate and 1 to 2 parts of kainit applied at the rate of \( \frac{1}{2} \) lb. to 4 lb. to each tree, according to its age.

Should the trees tend to get rank in growth, they may require root pruning, and this should be done as soon as possible after the leaves fall in autumn. In young trees, all the root pruning may be done at the same time, but in older trees, only part of it should be done, as it would be too great a check to a large and old tree to root-prune it all in one season.

The soil should be taken out, and a trench 18 in. to 2 ft. broad made, 2\( \frac{1}{2} \) to 4 ft. distant from the tree, according to the age of it, digging down until quite below all the roots. All strong roots should be cut off with a sharp knife, placing the knife under the root, and cutting upwards again, if possible at a place where root fibres appear. The trench should afterwards be filled, if possible with good loam round the cut roots, to provide good nourishment for the young roots. If the tree is old, the one half may be done one year and the other half the following season. Should the tree be very old, a third, or even a fourth, of the roots may be done each successive year, until the whole is finished. The tree will gradually change its habit, and instead of throwing up a quantity of useless wood the young fibres will gather more suitable food, and the tree will produce fruit buds and fruit.

If fruit trees have been neglected for some time, it will often be found necessary to thin out the branches considerably, as heavy crops of fruit may be borne, but very small in size and of inferior quality.

It is better to do this gradually, thinning out some of
the worst shoots the first season, others the next season, and so on, manuring the trees when necessary. The fruit then produced, though less in quantity, will be much superior in quality.

The picking of apples and pears should be carefully done, especially if they are to be stored. When the fruit can be plucked off the tree easily, or when found to be falling off itself, it is quite ready to be gathered. A further test is to cut one in half and look at the seeds. If these are plump and brown, the fruit should be gathered at once. If a strong wind comes about the time that apples are ready, it may play havoc with many of the best of them. Therefore, though they should not be gathered prematurely, it is wise to gather before the dropping stage. All fruits should be gathered in dry weather.

The fruit room should receive special attention, as it depends upon its suitability whether a good supply of apples is obtainable during a time of the year when fruit is scarce and expensive. It should be cool and airy, and constructed so that there is as little change of temperature as possible. The walls should be of good, strong boards, and should be double, allowing a space of from 4 to 6 in. between them. This space may be filled with sawdust, or any other non-conducting material, and the roof should be thatched with a heavy coating of straw, heather, &c. This should keep a very uniform temperature. There should be a ventilator in the roof to let out any moisture given off by the fruit, and the windows should have movable shutters. There may be a central tier of shelves, as well as shelves all round the sides, or there may be tiers of drawers which will enable more fruit to
1. "Chelm-Cord Wonder" 
2. "Blenheim Orange" 
3. "Cox's Pomona"
be stored in the same space. The bottom of the shelves or drawers should be perforated, to allow the air to get all round the fruit. If the fruit tastes of the wood, place a single sheet of paper between the fruit and the shelf. Only one layer of fruit should be placed on each shelf or in each drawer, and this should be regularly looked over, and all showing signs of decay removed at once, as one decaying fruit will soon infect many others.

There should be a small flue or hot-water pipe in the fruit room, so that in severe weather the frost may be kept out. On no account must fruit be kept warm, or it will shrivel. Neither should it be allowed to get very cold, and then have the temperature suddenly raised, or moisture will condense on the fruit. A uniform temperature should always be aimed at.

Only the best fruits should be stored.
Garden Work

Varieties—

Dessert
Charles Ross.  
Cox’s Orange Pippin.  
Coronation.  
Fearns.

King of Pippins.  
Mrs. Gladstone.  
Ribstone Pippin.  
Scarlet Nonpareil.

Kitchen
Bismarck.  
Bromley’s Seedling.  
Cox’s Pomona.

Hawthornden.  
Lane’s Prince Albert.  
Stirling Castle.

Dessert or Kitchen
Blenheim Orange.  
Cellini.

Early Julien.  
Edward VII.

CHAPTER VII

The Cultivation of Flowers

This department of gardening, though perhaps not so useful, is just as important as the cultivation of vegetables or fruits. We cannot make use of flowers as we do vegetables or fruits, but they bring pleasure to the minds of almost everyone, and when we are laid on a bed of sickness it is a great solace to see freshly cut flowers in our room, where we can feast our eyes on their exquisite colours and inhale their fragrance. Again, how the beauty of our garden is enhanced by the cultivation of flowers! Without their added beauty our gardens would lose much of their charm. It is therefore necessary to understand the cultivation of flowers, for there can be very few persons in the whole world who do not appreciate their beauty.
The Cultivation of Flowers

Flowers may be divided into three great classes—annuals, biennials, and perennials.

ANNUALS

Annuals are those the seed of which is sown in spring, and that make their full growth, flower, and produce seed, and then die down entirely in the one year.

The cultivation of such plants is extremely easy if due attention is given to the time and method of sowing the seed, as advised in chapter III; the smaller the seeds the shallower they should be sown.

After the soil has been properly prepared, the seeds should be sown thinly. April will be the best time to sow hardy annuals in the place where they are to flower; the hardier kinds earlier in the month, while the more tender ones may be sown later. When the seedlings appear, they should be thinned out before the plants have time to spoil each other, and thus prevent the beauty of the individual plants from being seen. If the plants have room to grow, the flowers will be larger than when crowded. Should the season be dry, thorough soakings of water must be given, especially in the early stages of the plants' growth.

Candytuft.—This is one of the annuals that is met with in most gardens. It is very hardy, and, as the seed is large, there should not be any fear of sowing too thickly or too deeply. If sown about 1 in. in depth, during the first week in April, and thinned out as soon as the seedlings are large enough, and have formed the first rough leaves, they will give a splendid display of bloom early in July. Candytuft may be had in various colours. The
colours may be alike for beds, borders, &c., or they may be mixed. An edging of mixed colours round the flower garden is very effective. With its straight stem, bearing the clusters of small flowers, it makes a most suitable flower for table decoration. It is about 1 ft. high.

**Chrysanthemum.**—This is another very pretty and useful annual, the seeds of which are fairly large. It may be sown about 1 in. deep, early in April, and when the plants have made two rough leaves they may be thinned out to give the others more opportunity to develop. In dry weather they ought to be thoroughly well watered at intervals. The beautiful large flower heads are borne on long stalks, which give the plant quite an outstanding appearance in the garden. They are also among the very best of this class of plants for supplying cut flowers for home decoration, remaining
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fresh for a considerable time when cut. Height, from 1 1/2 to 2 ft.

Clarkia.—This is another very pretty annual, the seed of which may be sown about 3/4 in. deep. Before the plants are too large they must be well thinned out. They make a bright display in the garden, and are also useful for cutting, the full-spreading petals of the flowers giving them a graceful appearance. Height, from 1 1/2 to 2 ft.

Convolvulus.—A very pretty annual, which well deserves a place in the garden. The large bell-shaped flowers, borne in succession on stout stems, give a very pleasing effect. The seed may be sown 1 in. deep, early in April, and thinned out when the seedlings are large enough. Thorough waterings should be given in dry weather. The somewhat soft flowers are not suitable for cutting, although the effect in the garden is very beautiful. Height, about 1 ft.

There are also climbing varieties of the same plant, the seed of which may be sown in suitable places where they can climb. The large bell-shaped flowers, borne at intervals on the stem, have a very gay appearance.

Cyanus minor (Cornflower).—Sow about 1 in. deep about the middle of April. Thin out when the plants are large enough. This is one of the most useful annuals for cutting purposes, the flower heads being borne on delicate but strong flower stalks. They stand for a considerable time after being cut, and give a free and natural appearance when mixed with other flowers. Height, 1 to 1 1/2 ft.

Dianthus chinensis.—Beautiful and useful annuals. Sow about 1/2 in. deep, and thin out when large enough. If very carefully handled, they may be transplanted. They
bear large flowers on strong stems, and keep fresh for a considerable time after being cut. Height, from 9 in. to 1 ft.

**Eschscholtzia californica.** — A very bright and showy annual. Sow during the middle of April, about \( \frac{1}{2} \) in. deep. It flowers very freely, and makes a pretty show in the garden. It is not so useful for cutting purposes as some of the other annuals. Height, about 1 ft.

**Godetia.**—One of the most showy of our hardy annuals, which should, if possible, find a place in even the smallest garden. The seeds are very small, and should be sown very shallow. On no account should they be sown thickly, for if overcrowded the plants will be spoilt. They should be thinned out to from 4 to 6 in. apart, when they will branch out and flower profusely. The large, brightly coloured flowers are very striking when planted in a clump or a line. They keep fresh for a considerable time when cut. Height, from 9 in. to 2 feet.

**Gypsophila elegans.**—This is not perhaps in itself
very pretty, yet from the large numbers of little white flowers which are borne on its slender stems it has a charm of its own. The small seed should be sown very shallow, about the middle of April, and thinned out to 4 in. apart, when the seedlings have made some growth. When cut, and mixed with other flowers, it gives the whole a light and graceful appearance. Height, 2 ft.

**Linum grandiflorum rubrum.**—Very pretty annual. Deep-scarlet flowers, which come out in succession, are borne on delicate stalks. The plants thus remain bright for some time. Seed is large, and may be sown about 1 in. deep. Sow about the middle of April. Thin out when seedlings appear. Flowers not useful for cutting, yet its brightness in the gardens makes it worthy of a place when room can be spared. Height, $1\frac{1}{2}$ to 2 ft.

**Lupins.**—These are very bright and useful plants, and deserve a place in any garden. Seed large. Sow 1 in. deep, early in April. Sow thinly, and thin out to 6 in. apart. The plants produce fine spikes, clustered with bright-coloured flowers. Not very useful for cutting. Height, $1\frac{1}{2}$ to 2 ft.
Matthiola bicornis (Evening Scented Stock).—Graceful and pretty plant. Seed small. Sow about $\frac{3}{4}$ in. deep, towards the end of April. When seedlings are large enough, thin out to 4 in. apart. A sweet scent is given off by the flower in the evening.

Mignonette.—One of the sweetest of all garden flowers. Seed is small. Sow about $\frac{3}{4}$ in. deep in succession from beginning to end of April. If done in showery weather, free from cold winds and frosts, the first sowing will be the best, as the roots will get deep into the ground before dry weather sets in; but if the season is cold and unfavourable, the later sowings will turn out best.

Thin out seedlings, when large enough to be handled, to 3 in. apart. No garden, however small, is complete without at least a small quantity of mignonette. A cool, moist position suits it best, and the soil should be fairly rich. If the soil is light and poor, frequent and thorough waterings should be given. To get a succession of flowers, sowings may be made at intervals during the summer, the last sowing being made at the beginning of July, when the weather is favourable, to produce a supply of flowers for the autumn. It is very useful for cutting and mixing with other flowers, on account of its delicate scent. Height, 6 in. to 1 ft.

Nasturtiums.—Very pretty annuals. Most satisfactory when grown on a somewhat poor soil. When grown on rich, moist soil, they make luxuriant plants, but do not flower so freely. Seed is large. Sow about $1\frac{1}{2}$ in. deep and 6 in. apart. They are very tender, and should not be sown until the beginning of May. These
flowers are admirably suited for an edging round the mixed flower borders, but are not very useful for home decorations. Height varies from 6 in. on poor soil to 1 ft. on rich soils.

There are also climbing varieties of Nasturtiums, which may be planted in suitable places against trellis-work, &c.

The seeds of these plants can be conveniently gathered as they ripen and drop off, and can be thoroughly dried and stored until the spring.

**Poppies.**—Very showy, and well deserving a place where room can be spared, as their brightly coloured flowers on long, slender stems make them an outstanding feature in the garden. The seed is very small, and should be sown very shallow, during April. When the plants are large enough they should be thinned out to 3 or 4 in. apart. The plants will then become strong, throwing out large flowers. They are useful for cutting if this be done before the flowers have been open too long; otherwise the petals will soon drop. Height, from $1\frac{1}{2}$ to 2 ft.

There are several varieties of Poppies, but the Shirley Poppies are of special importance and beauty.

**Schizanthus.**—A very pretty and effective annual (see p. 162). Seed should be sown $3\frac{3}{4}$ in. deep, and when large enough thinned out to 4 in. apart. The plants produce a large quantity of pretty flowers, with fringed petals, which are very effective in the garden, and which give a graceful appearance when mixed with other flowers for home decorations. Height, about 2 ft.

**Sweet Peas.**—The most popular of all our garden
flowers. Almost everyone who professes to be a gardener grows Sweet Peas in greater or smaller quantities. They are easy to cultivate, when a few simple rules have been attended to. The oldfashioned way was to sow fairly thickly, stick them when they got large enough, and leave Nature to do the rest, when they would form a very close row, producing enormous quantities of flowers, but very small, and having short stalks. Now, where a screen is wanted, combined with a pretty effect, this method, somewhat modified, may still be adopted. However, where the finest flowers are desired, a very different system of culture must be adopted. Instead of the old method of sowing outside, they are generally sown singly in 3-in. pots about the end of February or beginning of March, or four to six peas may be sown round the side of a 5-in. pot.
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The pots are placed in a cold frame, and brought on slowly. If the weather is at all bright they should be shaded until germination has taken place, keeping the soil uniformly moist; otherwise many of the seeds may not germinate. After the seedlings have come up, care will have to be taken to keep them well watered, and the light should be left off on all favourable occasions to ensure sturdy plants by planting-out time. This should always be done before the plants have any chance of becoming pot-bound; otherwise they may receive a check from which it would take them a long time to recover.

The soil for the pots should be a nice rooting medium of 4 parts good loam, 1 part leaf soil, with a small quantity of well-decayed horse manure, and enough sand to keep it open and sweet. If the soil where they are to be planted is naturally good, it should be trenched three spits deep, with an average supply of well-rotted

Sweet Pea
manure added to it; but if it is naturally poor, the soil should be thrown out to the depth of three spits and then filled up with a compost of good, turfy loam, 6 parts, leaf soil 1 part, well-rotted manure $\frac{1}{2}$ part, wood ashes $\frac{1}{2}$ part, and a 6-in. potful of bone meal to each barrowload of the mixture. When filling up the trench, its top should be left a few inches lower than the surrounding soil.

The plants should be set out 18 in. to 2 ft. apart, and should either be staked at once or "trainers" placed along the rows and the stems tied to them to give them a start, when they will branch out and fill up the intervening spaces between the plants. A good mulching of rough manure should be given, stretching for 2 ft. on each side of the rows. This will keep the plants cool in hot weather, and will also conserve the moisture for the use of the plants during short, dry spells. If, however, the weather continues dry, thorough waterings should be given. As the plants grow they should be kept tied up to the trainers. As soon as the flowers develop they should be cut. Never allow seed pods to grow—at least not until the end of the season, when flowers are no longer required.

Sowing outside may be done about the middle of March, in broad drills 2 in. deep, planting the seeds 6 in. apart, on soil which has been thoroughly trenched, and an average supply of manure added. As soon as they come up they must be staked. On no account should this be left too long, or the plants will fall over and so get spoiled.

If seed is to be saved, the varieties should be kept separate, and a good distance apart; otherwise the bees
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will pollinate the various flowers, thus effecting cross pollination and fertilization. The seed will then not be pure, and therefore the plants cannot be true to the varieties the following season.

The height varies according to the season. In hot seasons they may not grow more than 6 ft. tall, while in dull, showery seasons they may reach a height of 9 or 10 ft.

Varieties—

<table>
<thead>
<tr>
<th>White</th>
<th>Cream</th>
<th>Pink</th>
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<tbody>
<tr>
<td>Etta Dyke.</td>
<td>Nora Unwin.</td>
<td>James Grieve</td>
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<td>Clara Curtis.</td>
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<td>Czarina.</td>
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<td>Countess Spencer.</td>
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Salmon Shades

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<tr>
<td>Earl Spencer.</td>
<td>Henry Eckford.</td>
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<tr>
<td>Mrs. Hardcastle Sykes.</td>
<td>Princess Victoria.</td>
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</tbody>
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Lavender

Mauve

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<tr>
<td>Mrs. G. Charles.</td>
<td>Mrs. Walter Wright.</td>
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<tr>
<td>Cherry Ripe.</td>
<td>Chrissie Unwin.</td>
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<td>King Edward Spencer.</td>
<td>King Edward VII.</td>
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Cream Pink

<table>
<thead>
<tr>
<th>Orange Pink</th>
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<tbody>
<tr>
<td>Helen Lewis.</td>
<td>Miss Wilmott.</td>
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</table>
Orange Scarlet
Dazzler. Edna Unwin

Rose and Carmine
John Ingman. Marie Corelli.

Scarlet
Doris Burt. Queen Alexandra.

White Ground, Picotee-edged
Elsie Herbert. Dainty.

Cream Ground, Picotee-edged
Mrs. C. W. Breadmore. Evelyn Hemus.

Virginia Stock.—A most useful annual. Seed should be sown about $\frac{3}{4}$ in. deep, and plants thinned out so as to give the others room to develop. It makes a most effective border. Height, from 6 to 12 in.

All our annual flowers will succeed fairly well in almost any ordinary soil. Some, in fact, are more satisfactory on poor soil, producing less growth, but considerably more flowers. Some, of course, succeed better on a good, rich soil. There are many more annuals than those mentioned here, but the above is a general selection, with the method of cultivation of each. This should be a fair guide to the cultivation of any of the other kinds of annuals it is desirable to grow.

HALF-HARDY ANNUALS

Besides the foregoing, we have the half-hardy annuals. That is to say, they are annuals, but not so hardy.

They require to be sown in gentle heat, either in a cool greenhouse or in a frame on a gentle hotbed, earlier in the year than it is possible to sow them in the
open ground. This is necessary so that they can reach their greatest perfection during the summer, when they are wanted to give a display in the flower beds, or to supply quantities of cut flowers of the highest quality for home decoration.

If a small quantity only is required, the seed of any of these may be sown in pans or boxes, and placed on the shelf in a cool greenhouse, or in the frame on a gentle hotbed. If required in larger quantities, the soil may be made up and placed 4 to 6 in. deep on the top of the hotbed, and the seed sown directly in this, from February till the middle of April. The soil should be a nice rooting medium, with no lumps in it to break the roots when they are being lifted for pricking out. A suitable soil may be made up of 4 parts sifted loam, 1 part leaf soil, \( \frac{1}{2} \) part of sifted, rotten, dry, cow or horse manure, with enough sand to keep the whole open. It should be just moist enough to drop to pieces after being pressed firmly in the hand. The pans or boxes should be well drained, and then filled up to within 1 in. of the top. The seed should be sown very thinly, and covered over (evenly) with not more than \( \frac{1}{4} \) in. of soil. The latter details should apply equally to seeds sown in the frame. The boxes, pans, or frames should then be covered with paper or mats to keep the soil uniformly moist until germination has taken place. If by any means the pans or boxes become dry before the seedlings appear, they should not be watered overhead, but a large receptacle should be filled with water, and the boxes or pans placed in this, so that the water can rise gradually to the roots. On no account should they get so dry that the soil will
leave the side of the pan or box, or it will be found almost impossible to get the soil wet right through again.

When the seedlings appear, care must be taken to keep the pans or boxes near the glass, to prevent them getting drawn. Also, while watering, they should not be kept too wet, and so encourage the "damping off" disease. If the seeds are sown thinly there is little fear of this disease making its appearance.

As soon as the plants are large enough to handle properly, that is to say when they have made at least two rough leaves, they should be pricked out into boxes or frames from 2 to 6 in. apart. Or they may be planted on a sheltered border, where they grow slightly larger than when placed in boxes. They should be planted in good rooting material, composed of 3 parts finely chopped turfy loam, 1 part leaf soil, $\frac{1}{2}$ part well-rotted horse manure, and a sprinkling of sand. They should lift out of such a soil with a ball of soil attached to the roots, which will be a great advantage to the plants at planting-out time, especially if the weather is dry. Dull weather should, if possible, be always selected when pricking out, and the plants should be well watered after planting, and shaded for a few days until they have taken to the new soil.

A common mistake is often made in watering the seedlings immediately before pricking out. This should never be done, as, in "lifting" them, one is apt to strip off all the root hairs, which are of such vital importance to the plant at all seasons, but especially at this. Even if the seedlings are on the dry side, the soil particles will adhere to the root hairs, and thus protect them. The hole should be made large enough to allow the roots to go straight down, the
soil being then firmed. If this be done, the plants commence to grow as soon as watering takes place, and are not checked to any great extent. When the seedlings have taken thoroughly to the soil they should gradually be exposed, and more air given, increasing this on all favourable occasions until the plants become quite hardened. Planting out may be commenced about the middle of May, selecting dull, showery weather if possible. The soil should be thoroughly dug or trenched, and manured, to allow the roots to ramify easily in search of food and moisture. If it is trenched or deeply dug it will also hold more moisture, consequently the plants will not suffer very much if the weather continues dry. It also enables the roots to get
down below the drought, and the water to percolate more easily to them, while in wet seasons the superfluous water will more readily drain away.

When planting out such plants, plenty of room should be allowed for their full development. This will depend to a certain extent on the soil. On poor soils 6 in. may be found enough, while the same plants may require from 9 in. to 1 ft. on rich deep soil.

The following is only a general selection, there being many more kinds of half-hardy annuals. These, however, will be sufficient for this work.

*Ageratum, Imperial Dwarf.* Height, 9 in. Colour, blue.

*Aster,* of various kinds and colours. Height, from 6 to 24 in.

*Lobelia,* blue and white. Height, 3 to 6 in.

*Marigold,* African and French. Height, 1 to 2 ft.

*Nicotiana affinis,* sweet scented, white. Height, about 3 ft.

*Nicotiana macrophylla* (tobacco), large foliage. Height, 4 ft.

*Perilla nankinensis,* beautiful purple foliage. Height, about 18 in.

*Petunia,* Varieties, various colours. Height, 18 in.

*Phlox Drummondii,* Varieties, various colours. Height, 12 in.

*Salpiglossis,* Varieties, various colours. Height, 18 to 24 in.
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Stocks, Varieties, various colours. Height, 9 to 12 in.
Verbena, Varieties, various colours. Height, 12 in.
Zinnia, Varieties, various colours. Height, 12 to 18 in.

TENDER ANNUALS

We have also the tender annuals, which require the shelter of the greenhouse or conservatory during the whole
of their growth, from the seed until the end of the flowering period. They may be raised in the same way as half-hardy annuals, but instead of being pricked out they may be potted into small pots, and then, before these are quite filled with roots, they may be moved into larger ones, afterwards potting into the flowering pots. If time is limited they may be potted directly into the flowering pots, out of the small ones, taking great care not to overwater until the pots are fairly well filled with roots.

The following plants may be treated in this manner:

- Balsam, Camellia-flowered.
- Begonia.
- Calceolaria, large-flowered.
- Celosia.
- Cineraria.
- Cyclamen.
- Gloxinia.
- Primula sinensis.
BIENNIALS

Biennials are those plants which are sown one year and make a considerable part of their growth, but which finish their growth the following season, produce their flowers and seed, and then die away entirely.

Wallflower.—The common Wallflowers are examples of this class. The seed may be sown on a border from March to July, according to the climate and the time that it is wanted to flower. It may be sown thinly in drills 1 in. deep and 1 ft. apart. When the seedlings are about 2 in. high they should be pricked out into a nice border of fairly rich soil, in rows 18 in. apart, and 12 in. between the plants in the rows. Dull weather should be selected, if possible, for this work, and frequent waterings should be given until the plants take to the new soil. The hoe should also be kept going to kill the weeds, and let the air into the roots of the plants.

When the summer plants have died they may be cleared from the beds or borders, which should then be well dug over. If they have been well manured for the summer plants no manure will be required, as these plants must not grow too rank or soft, or they may be killed by the frost during winter. They may be planted in their permanent quarters, from 12 to 15 in. apart each way.

Myosotis (Forget-me-not).—This is another example of a useful biennial. The seed may be sown during April or May, in drills $\frac{3}{4}$ in. deep, and 12 in. apart. When the seedlings are large enough they should be pricked out on to a border, in rows 1 ft. apart and 6 in. between the plants.
Garden Work

When the summer plants have been cleared off the borders or beds the latter may be dug over thoroughly and the Myosotis transplanted, about 9 in. apart each way. In the early spring this should form a perfect carpet of beautiful little blue flowers. When once established, these plants can be kept going by simply lifting them after they have flowered, and planting them in some border which is not wanted, about 18 in. apart. The plants will then ripen their seeds, which will drop off and germinate. When the new plants are large enough they may be pricked off in the usual way.
Canterbury Bells.—Very pretty and showy biennials. The seeds may be sown in drills, about the middle of June. When large enough they should be pricked out in rows 9 in. apart, with 12 in. between the rows. In the autumn, when the summer plants are removed, these may be transplanted into their permanent quarters. They should have plenty of room—15 to 18 in. apart at least; they will then branch out splendidly, and make a striking show in the late spring.

Sweet William.—A very popular biennial. Seeds should be sown in April, in little drills \( \frac{3}{4} \) in. deep. As soon as large enough they should be pricked out on a border of fairly rich soil, and then, in the early autumn, put into their permanent quarters. In the following spring they will produce fine spikes of brightly coloured flowers.

There are many other hardy biennials, but the above examples will be sufficient as a general guide to their cultivation.

PERENNIALS

Perennials are plants which go on from year to year making considerable growth, producing flowers and seed, the stems dying down, but the root remaining alive in the ground and producing buds which send up stems the following season. Such plants are termed herbaceous perennials.

Other plants which grow on from year to year, producing flowers and seed, but which do not die down, are known as woody perennials.

The Herbaceous Perennials are those which we have to deal with here. They may all be raised from seed, which
may be sown in spring. When the plants are large enough they may be pricked out on a border, in rows 1 ft. apart, with 6 in. between the plants, where they may remain until the autumn, or even until the following spring, when they may be transplanted into their permanent quarters.

The principal way, however, of propagating herbaceous perennials is by division of the rootstock, just before growth commences.

Considerable attention ought to be paid to the arrangement of the herbaceous borders, the name given to borders on which hardy perennials are grown. The varying heights must be taken into account. These range from 6 in., in the case of the Auricula, &c., through various heights up to 6 or 7 ft., in the case of healthy Delphiniums.

Again, artistic taste must be brought into full play in the arrangement of the colours. This will apply only to plants that are in flower at the same time. No one would think of putting a clump of very pale blue Delphiniums in close proximity to a clump of deep-blue Campanulas.

On some soils certain plants will grow higher than one expects, and the colours or time of flowering may be misjudged. All these details should be noted during the summer, or flowering season, and as far as possible rectified during the following spring, until the border is quite right.

Another great aim should be to have a good succession of bloom for as long a period as possible, from the Christmas Rose, which pushes its head through the snow, to the Anemone japonica, which will flower until the frost cuts it down in the autumn. As the plants are of varying heights, some will require to be staked. This should be done as
early and neatly as possible, so that there is no chance of the plants getting doubled over. This spoils the appearance of the plants for the whole season.

The heights of plants should be ascertained, and the stakes cut so that the top will be just below the flower stalk. The plants will then be supported without the stake being conspicuous. Stakes should also be put widely round the plants, so that the latter will not have a bunched-up appearance when tied.

Another thing which should never be lost sight of in regard to the herbaceous border is tidiness. Owing to the fact that early and late plants are mixed, there are always some which are ripening and dying down, while others are at the height of their growth. It will be found difficult to keep the borders always tidy, as the plants must not be cut down as soon as they have done flowering, for the ripening process is necessary to mature the root of the plant for the following season. The only thing, therefore, to be done, is to keep the ripening plants tied up, taking out occasionally any stems which are quite dead, and picking off any unsightly leaves, until the whole plant can be cut down.

The plants very soon spread and become too large for the borders. Every spring, therefore, when the borders are being manured and dug—which process should not be done until the plants have all appeared above the soil—the plants should be divided by cutting the root clump either into halves or quarters, leaving one young piece, which will be as vigorous as the plant was the year before. In time it will be found necessary to renew the border altogether, as, when it becomes filled with plants of a fair
age, the border gets full of roots, and manuring is then difficult. When this becomes evident, the whole border should be trenched and thoroughly manured, clearing a part at one end, and trenching it, and then lifting the plants from the next piece, dividing them, and replanting nice young small pieces in the newly trenched part. This should be done in sections, until the whole is finished. This will prevent much handling of the plants. It may also be a time for improving the collection of plants, as there will always be plenty of plants for disposal, and some of these might be exchanged for other varieties. It is, however, a mistake to have too many varieties in a small border, and sufficient room should always be left to allow the plants to develop thoroughly.

The following are a few of the commoner herbaceous perennials.

**Achillea rosea.**—Height, about 2 ft. Colour, rose, crimson. Flowers in June and August.

**Anemone Japonica.**—Height, 2 to 3 ft. Colour, deep rose. There is also a white variety. The Anemone Japonica flowers from July to October.
Aquilegia. — Height, 2 to 3 ft. Various colours. Flowering season, June and July.

Arabis. — Height, about 6 in. Colour, pure white. Flowers in early spring. There is also a double-flowering variety, as well as a variety with variegated foliage.

Aster or Michaelmas Daisy. — Height varies considerably from 1 to 6 ft.; also vary greatly in colour, from white or pink to the various shades of blue; the newer varieties being very pretty.

Aubrietia. — This grows about 6 in. high. Colour, varying from intense blue to purple and mauve. Flowers in April.

Campanula. — Varies greatly, from the little Harebell, about 6 in. high, to the tall-growing Campanula pyramidalis, which will grow 6 ft. high. Some are pure white in colour, others are of varying shades of blue or lilac.

Delphiniums. — The most stately of our border flowers, growing to a height of 6 or 7 ft. The colour varies through different shades of blue, scarlet, and yellow.

Dianthus. — Varieties of Dianthus are among the prettiest and sweetest of our border flowers. Height,
from 6 to 18 in. Colours vary from white to deep rose.

**Dielytra spectabilis.**—A peculiarly pretty plant, with its long spikes of drooping flowers, which are a lovely shade of pink. A rather delicate plant, which should be placed in a sheltered position. Height, from 18 in. to 2 ft.

**Doronicum Caucasicum.**—A very useful plant in the garden. It flowers early, and the blooms keep fresh for a considerable time when cut. Of a yellow colour, and grows from 18 in. to 2 ft. in height.

**Funkia** and its varieties are very pretty, with their broad foliage, which in some instances is beautifully variegated, as in *Fundulata variegata*. The flowers, of white or lilac colour, are borne on stalks 15 to 18 in. high.

**Gentiana** varieties make very pretty border plants, growing from 3 in. high in the case of *Gentiana acaulis*, which is blue in colour, to the tall yellow variety, *Gentiana lutea*, which grows to a height of 3 or 4 ft.

**Geranium** (Crane's Bill) and varieties also make pretty border plants. Height, from 12 to 15 in., and wide range of colour, from dark blue to chocolate, rose and pink.

**Geum** and varieties.—Excellent for border. Height, about 2 ft. Colour, scarlet and orange.

**Gypsophila paniculata.**—One of the most useful of all border plants, which should find a place in every garden. Its fine branching habit and great number of very tiny white flowers give it a most graceful appearance in the border. It is invaluable for cutting, lending a charm to the whole when mixed with other flowers. Height, about 2 ft.
Helleborus niger or Christmas Rose.—Is peculiar in that it pushes its way through the ground in the middle of winter. If slightly protected with a hand glass, it may bloom at Christmas, and early in January. It is pure white, and grows from 6 to 12 in. high. Other colours are pink and dark red.

Hepatica triloba or Anemone hepatica.—A pretty little plant which pushes its little pink flowers through the ground before the foliage, quite early in the season. Another variety—Hepatica angulosa—has light-blue flowers. Height, 6 to 8 in.

Heuchera.—A pretty border plant, which produces small flowers on good stout stems, thus making it a very useful plant for “cut flowers”. The blooms are greenish, pink, or red in colour, and the plants grow from 12 to 18 inches in height.

Iberis or Perennial Candytuft.—A very showy plant for the front of the herbaceous border. It produces great
quantities of small white flowers on stout stems, the plants, when covered with bloom, adding greatly to the effectiveness of the border. Flowers in May, and grows about 9 in. high. It is easily propagated by cuttings, **Iris**, with its many varieties, make very showy plants in borders. The colours are many, ranging from white, yellow, or pink, to all the various shades of blue. The flowers are borne on stout stems from 1 to 3 ft. high.

**Lupins.**—Also very showy plants in the herbaceous border. The flowers—blue or white—are produced on stout stems from 18 in. to 2½ ft. high. There is also the tree variety, which is woody, and grows into quite a large bush.

**Lychnis** and varieties make an exceptionally bright show. The scarlet flowers are produced on stems from 18 in. to 3 ft. high.

**Mimulus.**—An extremely showy plant, producing large numbers of brightly coloured blooms of scarlet, yellow, rose, &c., on short stalks, on stems from 12 to 24 in. high.

**Pæony.**—Among the finest of our border plants. They produce enormous
flowers of various shades of colour, from pure white to purple and crimson. They are large plants, growing from 2 to 4 ft. high, and take up considerable room in the border, but where space is not limited their lovely flowers fully repay one for the ground they occupy. They flower during May and June.

**Papaver**, and its numerous varieties, are very showy plants of an orange colour—*Papaver orientale*—borne on strong stalks 2 ft. high.

**Potentilla**, with Strawberry-like foliage, and pretty yellow or crimson flowers, make a pleasing display. Height, about 2 ft.

**Pyrethrum** and varieties are among the most useful of our border plants. They produce large single or double Daisy-like flowers, on stout stems from 12 to 18 in. high. They keep fresh for a long time when cut. The colours vary from white to deep rose.

**Saxifraga** species are plants with a peculiarity of their own. Some make a moss-like growth not more than 6 in. high, producing large numbers of pretty little white, pink, or rose-coloured flowers, while others grow to a height of over 2 ft.

**Statice**, or Sea Lavender, is another pretty and useful plant, producing its tiny flowers in large numbers, on slender stems. It is useful in giving a light and graceful appearance to other cut flowers. Colours, deep blue, greyish, or pink. Height, about 2 ft.

**Veronica**, and some of its numerous varieties, are very pretty and showy plants, producing their spikes of tiny blue flowers on stalks from 12 to 24 in. high. They flower from June to August.
The above is only a small number of very pretty border plants, but should be sufficient as a representative selection for a work of this kind.

ROCKERY AND ROCK PLANTS

Where there is room in the garden there should always be a rockery, for the cultivation of some of those lovely little Alpine plants that cannot be successfully grown in any other way. It need not be large, but in keeping with the rest of the garden. If the garden is not more than ten poles, the rockery need not be more than two or three square yards. Here many of those striking gems, which look so exquisite in their natural habitat—the crevices of rocks on the mountain sides—may be successfully grown. If the garden is larger, the rockery may be in proportion, until in the very large grounds surrounding country mansions we may have quite miniature Alps, where fine collections of the numerous Alpine plants may be reared. Every advantage of natural beauty should be taken in forming a rockery, as here Nature is being imitated.

The size of the stones should vary with the size of the rockery, as large stones would look out of proportion in a small rockery, and vice versa. On a large scale, where the ground is naturally very uneven, it is not a difficult matter to form a rockery, whereas, in a smaller garden, where there are no natural advantages, it is there that one's ingenuity is taxed, to give such work the natural appearance which is indispensable to its success.

We will assume that the garden is a small one, and is quite flat. Having secured the site—one that will be exposed to as much sunshine as possible, for this is neces-
HYACINTHS ON A ROCKERY
The Cultivation of Flowers

The next thing to do is to work out the ground plan. This should be very irregular, considering its size. The surface soil should then be thrown out, and thoroughly cleared of weeds. The centre should then be filled with soil to form the mound, or miniature mountain, following the outline of the ground plan. The height should be about 18 in. for a small rockery, varying to 3 or 4 ft., or even more, in a larger one. The whole should then be covered with from 4 to 6 in. of stones, or even gravel, after which the rockery stones should be placed in position. They should all be placed sloping inwards, so that the soil will not wash out, and the water will be enabled to soak to the roots of the plants. The drainage will take away all superfluous water. After the stones are placed in position the soil should be placed in among them, to a depth of from 10 to 12 in. On the small rockeries, some of the lesser stones may be left out until some of the surface soil has been put in. When the whole is finished, the planting should be done. The very early spring is best suited for this operation, as many of the plants flower early, and they should be thoroughly established before it is time for them to produce blooms. A background should always be thought of, especially with regard to a small rockery, and no better one can be had than evergreen shrubs, such as Box, Yew, &c. These should be sufficiently far away not to overhang the rockery. On a larger scale, larger-growing plants may be used, and the partially shaded part of the rockery may be given over to a collection of hardy ferns. The soil for such will have to contain a considerable amount of peat, or leaf soil, and tree roots may be used instead of stones for the ferns to grow among.
In very hot and dry weather the rockery will need attention, to prevent damage from drought. It will also be noticed that some of the plants will grow more quickly than others, and these will have to be watched, or they will overcrowd the smaller and less robust ones. Under the artificial state of growth, it will be found that some of the plants will deteriorate, and the soil will become more or less exhausted. When this happens, the rockery should be thoroughly overhauled, some of the old soil taken away, and fresh soil put in its place. At the same time, renew any of the plants which show signs of decay, and thin out those which have outgrown their space. Most of the Alpine plants are readily propagated from cuttings, or by division, bringing them on in small pots in a cold frame until they are ready for planting.

The following are some of the commoner rock or Alpine plants:

**Achillea umbellata.**—A compact little plant with silvery leaves and white flowers. It is about 8 in. high.

**Alyssum saxatile compactum.**—Very compact, with golden flowers. Height, 3 or 4 in.

**Antennaria tomentosa.**—Pretty plant, with yellow and white flowers. It forms a carpet of white leaves.

**Arabis lucida.**—Bright-green leaves and white flowers. Also a variegated variety with golden margins to the leaves. Flowers in May and June.

**Arenaria balearica.**—Pretty plant with very minute leaves, producing great numbers of white flowers. Forms quite a carpet.

**Aster alpinus.**—Very small Aster, 6 to 8 in. high, producing numerous blue flowers in June.
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Aubrietia and its varieties form pretty trailing plants, which grow quickly over the stones, and are simply covered with blue, mauve, purple, violet, or carmine flowers. Height, 6 in.

Campanula and varieties, many of which are very pretty, growing from 4 in. high in the case of Campanula pulla, to 10 in. in the case of Campanula barbata.

Cerastium tomentosum.—Pretty silvery leaves and large white flowers.

Dianthus alpinus.—Pretty rock plant, producing large rosy crimson flowers on stalks 2 to 3 in. long.

Galium rubrum.—Compact-growing little plant with large numbers of small yellowish-white flowers.
**Gentiana acaulis.**—Compact plant with flowers of a deep-blue colour. Height, about 3 in.

**Geranium argenteum.**—Pretty plant with silvery, much-divided leaves, and flowers of pretty flesh colour.

**Geum montanum.**—Plant with soft hairy leaves and large yellow flowers. Height, about 9 in.

**Helianthemum** (Rock Rose) and its varieties.—Very useful rock plants. Flowers of many shades of yellow or red. Those suitable for rockery grow from 6 to 18 in. high.

**Linaria alpina.**—Alpine Toad-Flax. A charming little plant with purple flowers, each of which has an orange spot on the upper lip. Very dwarf, and flowers from July to September.

**Linum tauricum.**—Another useful plant which produces bright-yellow flowers in August. Height, about 12 in.

**Myosotis rupicola.**—A dwarf Alpine Forget-me-not,
producing in May large numbers of branching cymes, covered with fine blue flowers. Height, from 2 to 3 in.

**Papaver nudicaule.**—Exquisite little Poppy with flowers of a golden colour. Height, about 12 in.

**Phlox frondosa.**—A prostrate-growing plant, with an abundance of pink flowers which are produced in May.

**Potentilla aurea.**—Very dwarf, with large golden-coloured flowers. Height, 6 in.

**Primula,** and its many varieties, many of which are splendidly suited for rock plants. The colours of the blooms range from white, pink, purple, to magenta and crimson. Height, from 3 to 18 in.

**Ranunculus alpestris.**—A dwarf mountain Buttercup with white flowers. Height, 3 in.

**Saxifraga.**—A genus of plants which has many species especially adapted for the rockery. Some of them form moss-like plants which grow very rapidly, covering
the stones, and sending up slender flower stalks on which are borne blossoms of white, pink, or purple.

**Sedum.**—Another class of plants which are very suitable for the rockery. They prefer a sunny position. In many of these plants the foliage is of more importance than the blossoms. The leaves are large and fleshy, and take on various tints during the season. In some, the flowers are white or pink, while others are of a bright yellow.

**Sempervivum.**—These plants produce rosettes of fleshy leaves, the plants themselves being quite pretty, while the flowers are yellowish or pink. *S. glaucum* produces rosettes of pale-coloured leaves and flowers of a pale flesh colour borne on stalks 1 ft. high.

**Silene alpestris.**—A pretty little rock plant. Its flowers are pure white and are produced in June. Height, about 6 in.

**Statice nana.**—Flowers blue. Height, 4 in.
**Thymus micans.**—A dense green cushion with small pink flowers.

**Veronica pectinata.**—A very pretty rock plant which produces spikes of azure-blue flowers during May and June.

**Viola.**—Some of these are well suited for growth on the rockery, if placed at the base, where they are not exposed to too much sun.

The above is only a very small selection of rock plants. A larger selection will be found in some of the larger books on gardening.

**CARNATIONS AND ROSES**

These are of such importance in the garden that it is proposed to take them singly. They are considered to be the finest of all our garden flowers, and the cultivation of these beautiful plants is not so well understood as it should be.

**The Carnation**

This is not often met with in our cottage gardens, partly because of a want of knowledge of the proper method of its cultivation and partly because of the terrible disease which carries off so many of our plants. Another cause may be that those who raise the new varieties of this class of plants lay more stress on the fine blooms than on the robust constitution of the plants, which would enable them to resist better the ravages of the disease.

The seeds may be sown thinly in pots or pans, well drained and filled to within 1 in. of the top with soil. The seed should then be covered with $\frac{1}{2}$ in. of soil and placed on a gentle hotbed or in the greenhouse. The pots or pans should be afterwards covered with a piece
of glass and paper to keep the soil uniformly moist until germination has taken place. As soon as the seedlings appear, the covering must be removed. When high enough they should be pricked out on to a border which has been specially prepared by the addition of well-rotted manure and loam to the ordinary soil. They must be well watered in dry weather. These may remain on the border until the autumn, when they may be planted out into their permanent quarters. When they bloom, they should be carefully watched, and only the best plants, viz. those which combine the two special qualities of being robust and having flowers of distinct colours which do not split the calyx, should be kept for propagating purposes.

The general method of propagation is by layering. This should be done about the end of July or beginning of August. Good strong side shoots should be selected, from which the leaves should be carefully stripped to within a short distance of the apex. A sharp, clean knife should then be placed under the stem, cutting into the middle of it and then right up the centre through at least one joint. A very small piece of wood or stone should then be placed in the cut to keep it open. Previous to this, however, 2 in. of sandy soil should have been put down round the plant, and after scraping away some of the soil the shoots should be pegged down with wire or bracken pegs, and covered over with an inch or so of the sandy soil. These must be regularly watered if the weather is at all dry.

If the plants have rooted well they may be lifted and planted into their permanent quarters during the autumn,
or they may be left where they are during the winter and planted out in early spring. In some localities, with the finer varieties, it may be found necessary to lift and place the young plants in frames during the winter.

Carnations are also propagated by pipings. The shoots are sometimes too short for layering, or there are too many of them. They may be taken off with a heel or the foliage may be stripped off part of the shoot, which should then be cut through just below a joint. These can then be placed in sandy soil on a hotbed, firming the soil well round the pipings. The hotbed should be formed and 5 or 6 in. of sandy soil placed on the top of it, the whole being covered over with a layer of silver sand and the pipings inserted in this. They should then have a good watering and be kept close and shaded for a time. The soil should be kept moist, but damp should be guarded against until they are rooted.

A good loamy soil is the most suitable for the cultivation of Carnations. On light soils they are apt to be burned up in hot weather, while they do not like a stiff clay. If the soil is light, some clay or stiff loam and cow manure should be added, while if it is heavy, some sharp sand or road grit and leaf soil may be added.

As soon as the flower stalks get any size they should be staked. The most convenient kind is the spiral wire stake with a loop at the apex. These should be from 2 to $2\frac{1}{2}$ ft. high, and as the flower stalk grows it can be twisted round the spiral stake until it reaches the top, when it should be put into the loop. No tying is required, thus saving considerable time. If other stakes are used, the best are the thin points of bamboo canes. The plants
Garden Work

will have to be looked over regularly, and the flower stalks tied up until they have made their full growth. On no account should the stakes be higher than the flowers themselves. They should always be an inch or two shorter. If the season is dry, the carnations should be watered.

Diseases and insect pests will be dealt with in later chapters.

Varieties of Border Carnations—

*Almire*, bright yellow, edged and flaked rose.  
*Cassandra*, delicate flesh colour.  
*Cottage Maid*, pure white.  
*Duchess of Fife*, clear bright pink.  
*Duchess of Portland*, white ground, edged rose.  
*Duchess of Roxburgh*, yellow, marked with rose and lavender.  
*Francis Wellesley*, deep carmine rose.  
*Golden Eagle*, rich golden yellow, edged and marked red.  
*Granville Gem*, rich metallic heliotrope.  
*Isinglass*, rich crimson scarlet.

Roses

The Rose is the most popular of all garden flowers, and rightly so. Its beautiful form, lovely colour, and exquisite perfume unite in making it worthy of our care and attention. The small bushes which become covered with pretty flowers in their season may be planted as edgings to borders. Some of the taller-growing kinds may be planted partly on their sides and pegged down. They will then send up large numbers of flowering branches, thus making a complete flower bed of apparently dwarf-growing Roses, which has a very pretty effect.

We have also the bush varieties, which produce lovely blooms of fine size and substance; the standards and half
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standards, which may range from 2 or 3 ft. to even 6 or 8 ft. in height, according to the purpose for which they are wanted. Then we have climbing kinds of such varied forms that they are suitable for almost any kind of climbing. Some kinds may be trained against the walls of our houses, and another kind, with its large clusters of flowers, may be very effectively trained on trelliswork. Or we may train them on arches or pillars and chains, thus forming a living fence which in its season becomes a mass of exquisite blossoms. Again, what is more effective than a rose-covered porch? And even the solitary brier in some cottage garden has a charm of its own.

Roses will succeed fairly well on almost any garden soil which is not too light, but they succeed best on a rather heavy loam. Therefore if the soil should be too light it may be made more suitable by digging into it a quantity of loam, or even clayey soil, and manuring with cow manure. If the soil is a stiff clay it may be made more suitable by draining it and digging into it sharp sand, road grit, &c., and manuring with horse manure, as these will lighten it and make it more suitable for the growth of this particular plant. The ground should be trenched two or three spits deep, according to the depth of it, and left rough until planting time.

A great deal of the success of rose cultivation will depend on the method of planting. On no account should they be planted too deeply. If the roots get down into the subsoil they can never grow well. On the other hand, they must not be planted too shallow or they may be blown about by the wind, and in summer get too dry at the root.
The planting may be done any time after the leaves drop in autumn, until March, choosing suitable weather. If the roots should be very dry when the plants are received from the nursery they may be placed in water for a short time.

When planting, the roots should be first looked over, cutting all the damaged parts off with a sharp, clean knife. In all cases the holes should be made larger than the roots, to prevent the latter from being doubled up. They should then be spread out carefully in the hole, after which some very fine soil should be put in and allowed to fall gently among the roots. When these are covered with 2 or 3 in. of soil they should be made firm by treading, after which the hole may be filled up. Bush plants should be planted slightly below the place where the rose has been budded or grafted to the stock. Standards may be planted slightly deeper, as they will have more strain. The latter should always be staked as soon as planted, to prevent the wind from blowing them about. Roses will greatly benefit by a good mulching of cow manure in the spring or early summer, when the plant food will be washed down to the roots and the moisture conserved by preventing evaporation from the soil, thus keeping the roots cool. The mulch may be covered with a thin layer of soil if its appearance is unsightly.

Pruning should be done in spring after the frosts have gone and there is no danger of damage being done to the soft young shoots. It is better to allow the young shoots at the apex of the branches to be cut down than to prune too early and so force the lower buds into growth
when they may be badly injured by the late frosts. The knife should not be spared, either, on the rose bushes. Much more harm is done by not cutting enough out than by cutting too much. All the weak and useless wood should be cut right away, and the good strong shoots thinned out and cut well back to prevent overcrowding. The light and air must be allowed to get thoroughly into the bushes to ripen the wood; otherwise one cannot hope to get flowers of a high standard of quality. If the bushes are not cut well back they will grow very tall and the buds at the base will remain dormant, thus giving the bushes a very unsightly appearance.

In pruning the climbing varieties care must be exercised to keep the bottom of the bushes furnished with young growth; otherwise the result will be an array of bare stems, with perhaps a fine head of young growth at the top. To prevent this, two or three shoots should be cut down to near the base each season. Young shoots will then be sent up, and will keep the base of the wall, &c., covered with young wood and flowers.

Rose-growing for exhibition is a very interesting
hobby, and when successful the grower is amply repaid for all his care and trouble. The weather, as well as the plants, must be studied if perfect roses are desired. Should the first buds be too early they may be taken out, thus allowing the later ones to develop quicker and stronger. It may be necessary, however, just before the show, to keep back the blooms or even hasten them on. For the former, specially prepared shades must be obtained or made by covering a wire frame with canvas and fixing it to a stake. For the latter, disused glass globes or boxes with glass sides and tops and fixed to stout stakes will be necessary. Such coverings not only retard or hasten the blooms, but prevent them from being scorched by the sun or spotted and spoiled by rain.

When the blooms are for exhibition it is sometimes a matter of considerable anxiety to get them conveyed to the show, if it be any distance away. If they are to be shown on boards they should be carefully tied round with some soft material, as wool, &c. This should be fastened round the middle of the bloom, just tight enough to keep the petals in position. The blooms should then be placed in the tubes on the boards, first covering the latter with green feathery moss. The board or boards may then be placed in a box and conveyed any distance with safety. On arrival, the tubes should be refilled with water and the ties taken off.

If they are to be shown in vases, the blooms should be tied round in the same way and carefully packed in a box or basket, taking off the ties before arranging at the show.
Varieties—

**Hybrid Perpetual Roses (H.P.)**

*Baroness Rothschild*, delicate rose colour.
*Beauty of Wa tham*, rosy crimson.
*Captain Christy*, delicate flesh colour.
*Duke of Edinburgh*, brilliant vermilion.
*Frau Karl Druschki*, pure white.
*Mrs. John Laing*, soft pink.

**Tea-scented and Noisette**

*Bridesmaid*, clear pink. (Noisette.)
*Catherine Mermet*, light flesh colour.
*Madame Pierce Cochet*, deep golden yellow.
*Mrs. Edward Mawley*, bright carmine.
*Muriel Graham*, pale cream, slightly flushed with rose.
*The Bride*, pure white.

**Hybrid Tea-scented Roses (H.T.)**

*Admiral Dewey*, light blush.
*Alice Lindsell*, creamy pink, white centre.
*Caroline Testout*, salmon pink.
*Dean Hole*, silvery carmine, shaded carmine.
*Duchess of Portland*, pale sulphur yellow.
*John Ruskin*, bright rosy carmine.

**Climbing Roses**

*Bouquet D'Or*, deep yellow, centre copper colour.
*Climbing Captain Christy*, delicate fleshy white.
*Climbing Frau Karl Druschki*, pure white.
*Crimson Rambler*, bright crimson.
*Dorothy Perkins*, light pink, white centre.
*Gloire de Dijon*, buff, orange centre.

**Polyantha Roses**

*Anna Marie de Montravel*, pure white.
*Cecil Brunner*, bright rose.
*Mrs. W. Cutbush*, pale pink.

**Bourbon Roses**

*Madame Isaac Periere*, carmine.
*Souvenir de la Malmaison*, creamy white, blush centre.
Garden Work

China Roses

*Belle de Florence*, light carmine.
*Fabvier*, scarlet crimson.
*Queen Mab*, rosy apricot.

Lord Penzance's Hybrid Sweet Brier

*Amy Robsart*, deep rose.
*Flora MacIvor*, pure white.
*Lord Penzance*, soft fawn.

Moss and Perpetual Moss Roses

*Henry Martin*, crimson, shaded carmine.
*Reine Blanche*, creamy white.

The above is a small selection of roses, but it should be found enough for a work of this kind. The reader who contemplates forming a rose garden, or even a small collection, will get all information about the very numerous varieties in each section from any good nurseryman.

Bulbs

No garden is complete without at least a few bulbs, for they are of such easy cultivation, and the result is so gratifying, that no one need hesitate to grow these charming flowers. Expense is the greatest item to contend with, as many of the bulbs, such as Hyacinths and Tulips, only flower satisfactorily for one year. Others, however, such as the Narcissus and Daffodil, come up and flower well year after year.

The Snowdrop.—This is a most graceful flower, and very easily established in almost any garden soil. The bulbs should be planted 3 in. deep, and quite close together. They will then come up in nice clumps. They seem to
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thrive best when planted in shady places, such as at the foot of trees, &c. They make their appearance through the soil in very early spring, sometimes even before the snow has disappeared from the ground. When once planted, they should not be disturbed. They will then gradually increase, and form large clumps, and flower very freely. They may also be planted on banks among the grass, where they will flower before the grass grows to any height; but the grass should not be cut on any account until the foliage has ripened off, as this is necessary to mature the bulbs for the following season's flowering. Therefore they should not be planted in the grass where they cannot be left until the foliage dies down.

Chionodoxa

Chionodoxa.—Another pretty little flowering bulb, which is not so much grown as it might be. Its pretty
little white, lilac, or blue flowers, which are sent up very early in the spring, make it a very welcome addition to the few flowering plants at this season of the year. The bulbs should be planted about 2 in. deep. It is a suitable plant for growing in small clumps on the rockery.

**Crocus.**—One of the most popular flowering bulbs. It is inexpensive, and grows freely year after year. The bulbs should be planted about 3 in. deep, early in November. They form pretty edgings to beds or borders, or the various colours may be mixed together, thus making complete beds in themselves. They may also be planted in grass, but here again the grass must not be cut until the foliage has died down.

**Tulips.**—These are pretty and useful flowering bulbs; pretty because they beautify the garden, and useful because they may be cut for home decorations. They are more or less expensive, however, as they do not flower well for more than one season.

The bulbs may be planted early in November, about
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3 in. deep. They will thrive well on any garden soil. If the soil is stiff and clayey, the holes may be made 1 in. deeper, and about 1 in. of sand put in for the base of the bulb to rest on.

They may be planted in beds for garden decoration only, or planted on borders with a view to the blooms being used for home decorations. Many are suitable for wreaths and bouquets, especially the white varieties.

Varieties—

<table>
<thead>
<tr>
<th>Variety</th>
<th>Height.</th>
<th>Colour.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duc Van Thol</td>
<td>7 to 8 in., various.</td>
<td></td>
</tr>
<tr>
<td>Cottage Maid</td>
<td>9</td>
<td>white and rose (single).</td>
</tr>
<tr>
<td>Prince of Austria</td>
<td>12</td>
<td>orange red</td>
</tr>
<tr>
<td>Yellow Prince</td>
<td>9</td>
<td>golden yellow</td>
</tr>
<tr>
<td>La Candeur</td>
<td>11</td>
<td>pure white (double).</td>
</tr>
<tr>
<td>Murillo</td>
<td>10</td>
<td>pale rose.</td>
</tr>
</tbody>
</table>

Parrot Tulips

<table>
<thead>
<tr>
<th>Variety</th>
<th>Height.</th>
<th>Colour.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cape Brun</td>
<td>9 in.</td>
<td>brown and yellow.</td>
</tr>
<tr>
<td>Cramoisie Brilliante</td>
<td>9</td>
<td>deep crimson, black centre.</td>
</tr>
</tbody>
</table>

Darwin and May-flowering Tulips

<table>
<thead>
<tr>
<th>Variety</th>
<th>Height.</th>
<th>Colour.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carminea</td>
<td>22 in.</td>
<td>brilliant scarlet.</td>
</tr>
<tr>
<td>Clara Butt</td>
<td>19</td>
<td>pale salmon rose.</td>
</tr>
<tr>
<td>White Queen</td>
<td>24</td>
<td>white tinted blush.</td>
</tr>
</tbody>
</table>

Hyacinths.—Very popular but expensive flowering bulbs, and, like Tulips, do not flower so well after the first season in many of our garden soils. They should be planted 4 in. deep. If the soil is wet and heavy, the hole—made with a dibber or small trowel—may be made 5 in. in depth, and about 1 in. of sand put in for the base of the bulb to rest on, until the roots have started.

There is nothing among the flowering bulbs to compare with a nice bed of hyacinths of various colours. The large
flower spikes, closely covered with wax-like bells, make a charming picture, which well repays one for the expense incurred.

Varieties—

Ivanhoe, dark blue.
Grand Maitre, clear blue.
Lord Balfour, purple violet.
Lord Macaulay, carmine and rose.
Moreno, light pink.
Admiration, pure white.
Anna Carolina, light yellow.
President Roosevelt, bright rose (double).
Princess, deep pink (double).
Florence Nightingale, pure white (double).

Narcissus and Daffodil.—These are the most useful of all the bulbs. They make a splendid show in the beds, or borders, and they are the most suitable for cut flowers. They will succeed very well in any garden soil. A good loamy soil, however, is the best. They should be planted about 4 in. deep, from the end of October to the end of November, to get a succession of bloom in the spring. They may be planted in beds or borders, or in clumps in mixed borders for cutting. They are also useful for massing on banks, &c.

Varieties—

Emperor, primrose.
Empress, trumpet rich yellow, perianth white.
Golden Spur, deep yellow.
Beatrice, perianth pure white, cup pale apricot.
Grand Duchess, perianth silvery white, cup pale orange.
Poeticus Ornatus, perianth pure white with red-edged crown.

Bulbs should be planted with the trowel, or with a flat-
POLYANTHUS NARCISSUS—"HER MAJESTY"

TULIP—"COTTAGE MAID"
end dibber, or, if planting in beds or borders, a small trench may be made, so that the bulbs may rest properly on their base. Bulbs may also be planted with other plants as a groundwork, i.e. plants which flower about the same time, such as White Arabis—single or double—with Scarlet Tulips; Myosotis and Pink Tulips; Wallflowers with Daffodils, &c. Such combinations have often a very pretty effect, and effect a considerable saving in the bulb account.

CHAPTER VIII
Window Boxes and House Plants

Before leaving the subject of flower culture it would be well to give a few details with regard to the above department of gardening. To many—especially in our towns—this is the only form of gardening possible; but even in the heart of London, this is, to a great extent, possible. When we come to our smaller towns and villages we have an atmosphere where plants in window boxes may be grown to perfection.

Window boxes may be made of any kind of wood, oak being the most durable. When covered with cork
they look very well. Holes should be bored in the bottom for drainage. An inch of broken pots or stones should also be placed at the bottom, and covered with moss or decayed leaves. The box should then be filled to within $1\frac{1}{2}$ in. of the top with a compost of good loam 4 parts, leaf soil 1 part, and $\frac{1}{2}$ part of horse manure, with a little sand. About the end of May the window boxes may be filled with Geraniums, Fuchsias, Marguerites, Calceolarias, Lobelias, Nasturtiums, &c. A window box planted with Scarlet Geraniums and Marguerites at the back, Calceolarias and Fuchsias in the centre, with Ivy-leaved Geraniums and Lobelias in front makes a very pretty show. The Geraniums hanging over the front of the box to a depth of 18 in., and the Marguerites and Scarlet Geraniums growing 15 in. high at the back, will give a mass of flowers and foliage nearly 3 ft. broad, and will not only have a charming effect, but will relieve the monotony of what would otherwise be bare walls.

During the winter the boxes need not be empty. They may be filled with Wallflowers and Forget-me-nots, Arabis and bulbs, either mixed or alone. The boxes should be taken down, the soil turned out and mixed with fresh soil, the drainage should be put back with moss or leaves over it, and the soil then replaced. This should be done about the end of October or beginning of November, when the plants and bulbs may be put in, and the boxes returned to their places. Wallflowers and Daffodils, Arabis, or Forget-me-nots and Tulips, Wallflowers alone, or bulbs alone —such as a row of Tulips at the back, Hyacinths in the middle, and Crocuses in the front—make pretty displays in spring. The Tulips and Hyacinths may require to be
Window Boxes and House Plants

staked when the flower stalks grow, to prevent them being broken by the wind. The stakes should be small, and carefully hidden by the flower, so as not to spoil the appearance of the boxes.

When the spring plants have flowered, fresh soil will have to be obtained for the summer plants.

Large vases may be filled in the same way. These lend an additional charm where they can be placed at the corner of a path, &c., but this should not be overdone.

WINDOW AND HOUSE PLANTS

This is a branch of gardening in which almost everyone is interested, but which is not understood as it might be. Only such plants as are suitable for this culture should be used. When gas is used for lighting, care must be taken that there is not even a slight escape, as this is injurious to pot plants.

Flowering plants of course require all the light possible, and should be placed in or as near the window as possible, whereas Ferns, &c., which require shade, should be placed in other parts of the room.

It may sometimes be found advisable to take the flowering plants to other parts of the room for decorative purposes, but they should be returned to the window as soon as possible. Plants in windows require to be turned regularly to ensure normal growth. It is in the leaves of plants under the action of sunlight that all the food is manufactured for their growth. Therefore the leaves and also the shoots will turn themselves to the light, so that this work may be more rapidly carried on. This is
called heliotropism, or turning to the sun. If this “growing to the sun” is checked by the plants being turned regularly, they will grow quite normally. Potting should always be done in the early spring, just before active growth commences. The pots will then speedily be filled with roots. If the plants require a larger pot, the ball may practically be left intact, shifting it into a pot only large enough to allow a little fresh soil to be put round, underneath, and on the top of the ball. About \( \frac{3}{4} \) inch of space should be left at the top of the pot to allow for watering.

If the plant is already in a pot of sufficient size, the ball should be gently shaken out, and as much of the old soil removed as possible. It should then be placed in a clean pot of the same size, and refilled with fresh soil, leaving a space at the top of the pot to allow for watering.

Pots for repotting should always be thoroughly clean inside and out. If they are not clean inside, watering cannot be done properly, and the plants will not turn out of the pots, as the roots will adhere to the sides.

Good drainage must be secured by placing pieces of crock over the hole in the bottom of the pot; these should be covered with smaller pieces, placing over the whole a layer of moss or half-decayed leaves. This will prevent the soil from getting down among the crocks and stopping the drainage.

A good general compost may be made up as follows: 4 parts good fibrous loam, 1 part leaf soil, \( \frac{1}{2} \) part decayed horse or dried cow manure, and about \( \frac{1}{10} \) part of sand, while a 6-in. potful of bone meal may be added to every
barrowload of the compost. Ferns, of course, require plenty of peat in their compost. Soil suitable for them should be made up as follows: 4 parts peat, 2 part fibrous loam, 1 part leaf soil, and \( \frac{1}{3} \) part sand. Potting soil should neither be too wet nor too dry. A good test is to press a handful of it tightly in the hand. Then, when the hand is opened, if the soil just drops to pieces it will be suitable. If it sticks together in a ball it is too wet. When potting, the soil should be made fairly firm for all house and window plants. No possible harm can be done on the side of firmness if the above precautions have been taken.

**WATERING**

It is quite impossible to give exact instructions on paper as to watering. So much depends not only on circumstances, but on the kind of plant, the season of the year, the place where the plants are growing, &c. Certain rules, however, may be laid down for general guidance.

First of all, the pots should be gently tapped with the knuckles. If they emit a clear ring, water is required. Or the pot may be taken between the fingers and thumb, the fingers being inside the pot and gently pressing the soil. If this feels at all dry and dusty, the plant requires water. Experience may very soon be gained by those who try it and watch results. If by any chance the plants get so dry that the soil leaves the pots, the plants must be stood in water so that the pots are completely covered. They must be left until the air bubbles cease to rise from the soil. If, on the other hand, plants are watered too freely, the whole of the spaces between the
particles of soil get filled up with water, and air cannot get in, thereby causing injury to the plants. The particles of soil should only have a film of water round them, the spaces between being filled with air, which is necessary for the growth of the roots.

One of the first signs of insufficient water is the drooping of the leaves. If this is continuous, they may dry up and drop altogether. In the case of Aspidistra, Dracæna, Palms, &c., the tips of the leaves become brown and dried up. This latter condition, however, may be due also to overwatering, as it is always the tips of the leaves that suffer first.

It is immediately after repotting that the greatest care should be exercised in watering. Never allow the fresh soil to become water-logged, or the roots will decay and the plants die. Neither must the plant become too dry, or the young roots will be injured also.

House plants, in time, get more or less dusty, therefore they require to be sprinkled occasionally with water. During the summertime they may be put out in the rain, when they will be freshened up remarkably. The breathing pores in the leaves (stomata) will be washed free of dust, and the plants will be made more healthy. No greater mistake, however, could be made than to put plants from a more or less warm room out into a cold rain during springtime. This gives the plants a severe check.

The plants most suitable for growing in windows or in rooms, are:

For Rooms.—Aspidistras, Dracænas, Hardy Palms, Chamaærops excelsa, Corypha australis, Phænix rupicola.
Window Boxes and House Plants


For Windows. — Fuchsias, Pelargoniums, show varieties—Zonals—Ivy-leaved varieties, Scented-leaved varieties—Petunias, Primulas, Begonias, fibrous- and tuberous-rooted varieties — Campanulas, Chrysanthemums, Cinerarias.

The Fuchsias and Pelargoniums may be dried off to a certain extent during winter, but they should never be allowed to get too dry, or some may not start in the spring. The spring-time, just after potting, is the most difficult time to manage house and window plants. If a greenhouse is available that is all that is necessary, but if not, a great deal may be done with a hotbed and a frame. Here the plants

Tuberous Begonia
might get a little extra bottom heat to stimulate growth, and they could be sprinkled over with water in the mornings and afternoons during bright weather, thus giving them a nice start for their summer quarters in the window. Meanwhile, their places may have been taken by Calceolarias, Cinerarias, and other spring-flowering plants.

The frame will be used for growing these annual spring-flowering plants, and also for striking cuttings, &c.

Cuttings of Pelargoniums may be taken either in the autumn, when the plants are cut down, or in spring; while cuttings of Fuchsias may be taken in spring when the shoots are large enough.

CHAPTER IX

The Greenhouse and Frame

Where a greenhouse can be added to the general equipment of the garden it will be found of very great importance, and will widen the scope of this subject to a considerable extent. We can then understand the fundamental principles of growing plants under artificial conditions—for such is growing plants in glass structures, whether greenhouses (cool), or stoves (warm), or conservatories (either cool or warm), or vineries (for grapes), peach houses (for peaches), orchard houses (for various fruits, &c.). The growing of plants under such conditions is vastly different from their growth in their natural habitat. Hence it is for the successful gardener to find out the necessary conditions under which his various plants will grow.
In a greenhouse, plants are under perfect control, but the regulation of the temperature must be well understood; how to admit the necessary supply of fresh air, and how to apply water to the roots of the plants; also when to supply or withhold moisture from the atmosphere.

The heat must be regulated according to the class of plants grown in the house. If their native country is warm, then the house will have to be warm also; but if their native country is cool, the house must be kept cool for their successful cultivation. All plants, those from warm countries as well as those from cool ones, require fresh air, and it is a most difficult matter to supply this, especially during our severe winter season. On no account must there be draughts in the plant houses; plants are living things, and suffer very readily if exposed to draughts. Everyone knows that chills and colds are contracted as the effect of sitting in a draughty place. Though we cannot,
perhaps, say that a plant "catches cold", at any rate we know that their growth is checked, and, if tender, they may be killed by draughts. To avoid this we must admit the air very cautiously, and at places where it will not come into direct contact with the plants before mixing, to some extent, with the warmer air of the house. This may be accomplished by having ventilators at the apex. When the cold air enters, being heavier than the air inside the house, it naturally descends, and thus becomes warmed in passing through the warm air before reaching the plants. Some of the warm air is driven out, and other cold air enters, thus establishing a circulation without draught.

Sometimes, however, it is necessary to admit more air than will enter by the top ventilators, especially as spring and summer approach. The front ventilators now require to be opened. These, if possible, should be placed so that the cold air will pass over the hot-water pipes, and thus become warmed before reaching the plants. In this way an abundant supply of fresh air may be admitted without any fear of danger to the plants. The spring is the most difficult time of the year in which to ventilate the greenhouse properly. The plants are starting to grow, and the young growths are very tender, and liable to be injured by cold currents of air. The writer well remembers an incident which happened shortly after he started his gardening career. It had been a frosty morning, the air was sharp and clear, and the sun came out very strongly. He was in entire charge of the ranges of houses, one of which was a stove, which had been heated in the morning to keep up the temperature. When the sun came out, he immediately damped down the fires; but still the ther-
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The thermometer rose higher and higher, from 60° to 65°, and up to 75°. Being afraid to admit the frosty air, the door between the stove and greenhouse was opened. This had little effect, and the thermometer rose to 85°. In desperation the top ventilators were opened, to prevent the plants from being destroyed by the heat, as was thought. The consequences would have been very serious had not an experienced gardener come and shut up the house, putting the plants right, and the writer at his ease, with regard to the sun heat on houses (which is only temporary), and the danger of admitting frosty air into a warm house filled with tropical plants.

Watering plants is another serious matter to the beginner, and requires careful attention. One hears gardeners saying how seldom they get men who thoroughly understand this all-important operation. However, if we go to the root of the matter, and find out the principles underlying the practice of watering, we shall be better able to water our plants successfully.

First of all, it is common knowledge that plants require water, just as we require it, to drink, though the following incident will show that everyone does not know this elementary fact. A lady visited a nursery in a country town, and purchased a beautiful heath in full flower. About a week afterwards she brought it back, the points of the shoots hanging limp, and apparently in a dying condition. She asked the nurseryman why the plant should look like that, and on his telling her that all the plant required was water, she said: "Why didn't you tell me that it required water?" Of course such ignorance is not general.

When the young gardener begins watering, he is
generally taught to tap the pots, and if they emit a bell-like sound he is told they require water. Afterwards, as he gains experience, he can tell to some extent when a plant requires water by the appearance of the surface of the soil. But a good gardener ought to know more about this subject.

To begin with, he places crocks in his pots to drain away the superfluous water; then mixes his soil in such a way that there are sufficient gritty particles (sand) in it to ensure that the superfluous water will drain through it. But we know that plants require water at all times, to a greater or less extent, and therefore we must supply it when it is required, and only then. When we water a perfectly drained pot, where the soil is suitably mixed, a considerable portion of the water will pass through. This is necessary to ensure that the whole of the soil has been watered. All the water, however, does not pass through. A tiny film is left round every particle of soil, but between the particles are the essential air spaces. It is this film of water round the particles of soil which supplies the plant. The rootlets, with their absorbing root hairs, cling to the soil and suck up this film and the liquid plant food with it. As soon as this water is exhausted, more must be supplied, or the cells will get partially emptied (for water is always being given off in transpiration during the growing season), and the plants will thus droop. If plants show signs of drooping they should be watered at once, but even then, with some plants, the mischief will be done. We must, therefore, understand our plants and the conditions of their growth, and be able to determine when to give the necessary water before that previously supplied has been used
up. By tapping the pots this can be determined to a great extent. With a little experience one can detect the various rings of the pot, and thus ascertain, if water is required, if at once or later on. Again, by rubbing the forefinger on the top soil it is easily ascertained whether it is wet or dry. On the other hand, if too much water is given, it fills up the spaces between the particles of soil, and air cannot get to the roots of the plants nor into the soil to allow the little organisms (bacteria) to do their work of changing the manure, &c., into liquid plant food. Should this state continue it will become stagnant in the soil, and the plants will certainly die.

Of course when the fundamental principles of watering are grasped it is only a matter of experience with close observation.

Some plants are adapted for growing under water, or partly under water, such as Nymphaeas, or some of the Ranunculaceæ, &c. These plants have special adaptations for breathing, such as large air spaces in stems, leaves, stalks, &c. Further, we have plants which require very little water and which have special adaptations for conserving the water at times, such as the Cacti, &c., with their thick, fleshy stems.

The moisture required in the greenhouse itself varies to a great extent according to the season and weather, and according to the kind of plants growing in it. During winter it is advisable to keep the house as dry as possible; otherwise, with a humid atmosphere, dull weather, and very little growth going on, the plants are liable to be attacked by disease, especially the "damping off" disease (Pythium). But in late spring and summer, with warm days, bright
sun, and vigorous growth, it is a great advantage to damp down the stages and paths once or twice a day, as this keeps the house cool, and produces a nice healthy growing atmosphere. It also prevents excessive transpiration and consequent danger of the plants becoming quickly dry. When there are many plants in bloom, however, care must be taken not to have the air saturated with moisture, or some may condense on the flowers, and speedily destroy them.

There is a very long list of greenhouse plants, and to describe them all in detail would fill a considerable volume in itself. It is unnecessary in a book of this kind, as the variety of plants which could be grown successfully in a small greenhouse must be small.

**Hyacinths.**—The first plants and flowers of the year are generally the bulbs, the Roman Hyacinths being the earliest. Preparation for securing these plants in bloom about the New Year, however, must be made a considerable time before. The dry, ripened bulbs should be purchased towards the end of September, and three may be placed in a 4-in. pot, or four in a 5-in. pot. The pots should be well drained, and the soil should consist of 3 parts of fibrous loam, 1 part of leaf mould, $\frac{1}{2}$ part of well-decayed horse manure, with about $\frac{1}{12}$ part of sand. Some moss or half-decayed leaves should be placed over the crocks for drainage, then about 2 in. of the compost put in, and the bulbs placed on this, after which more of the compost should be put on and firmed down until the apex of the bulb is just covered. This should leave $\frac{1}{2}$ in. of space at the top of the pot to allow of plenty of water being given when growth has well started. When potted,
a good watering should be given, and the pot plunged into ashes (which should be damp but not wet) in a place where they can be protected from heavy rains. They may remain in this position without any further attention until growth has started. When the leaves have grown about $\frac{1}{2}$ in., the pots may be taken out of the ashes and put into the greenhouse, and watered as required, gradually increasing the amount as growth proceeds. Small stakes should be placed round the pots, and one or two strands of bast tied round to prevent the flower stems from being bent or broken. The ordinary Hyacinths may be treated in practically the same way, only about two months later. The flower spikes of this species, however, are much heavier, and require a small stake for each spike. As the smallest wooden stakes appear somewhat clumsy, it is better to use wire stakes. Wire as thick as an ordinary knitting needle is strong enough. It should be cut about the required length, and a small ring formed at one end. This should be turned to the side and then pushed into the soil beside the bulb, the ring at the top opened, and the stem put into it, then closed again. Thus no tying is required.

**Daffodils.**—These may be potted also, and treated in much the same way as advised for Hyacinths, using the same compost, but the pots should be larger; four to six bulbs should be placed in a 6-in. pot, or six to eight may be placed in a 7-in. pot, when they will produce nice pots of foliage and flowers for either greenhouse or room decoration. They may be staked with the wire stakes also, especially the double varieties, which are apt to break over with the weight of the blooms.

**Tulips.**—These should be placed in smaller pots as
a rule, using the same compost as for Hyacinths and Daffodils. By placing four bulbs in a 4-in. pot (plunging them in ashes until growth commences), nice plants, suitable for either room or greenhouse, may be obtained. The shorter-growing varieties will not require staking, but the taller sorts require support. Wire stakes should be used, placing them on the inside of the plants, when the flower stalks will hide them to some extent.

If Tulips, Roman Hyacinths, or Daffodils are required in large quantities for cut flowers, the bulbs may be placed in shallow boxes quite close together. The boxes should be drained by placing pieces of crocks in the bottom, covered with a layer of the roughest of the same compost as used for potting, after which the bulbs may be placed fairly close together, and covered over with more of the compost, watering them, and plunging them in ashes until growth commences. When growth has started, the boxes may be lifted and placed on shelves in the greenhouse, and kept well watered until they come into bloom. Tulips grown in this way may be carefully lifted out of the boxes, and planted in fancy pots or vases for room decoration. Some care, however, is necessary in supplying sufficient water after transplanting.

When the initial details of bulb-growing are grasped there is no difficulty in cultivating them successfully. They must not be overwatered until growth has well commenced, but after this, if the pots are well drained and the compost contains enough sand to keep it open (or porous), there is little fear of overwatering them. If long stalks are required for cutting, the plants (after growth has commenced) should be kept in the dark for some time, and
some distance from the glass, after which they should be gradually brought into the light.

**Primula sinensis.**—This pretty, free-flowering plant should be grown in all greenhouses. It is a little difficult, perhaps, to cultivate, owing to its tender growth.

The plants should be raised from seed each year, the first sowing being made early in March. The compost used should consist of 3 parts of loam, 1 part well-rotted leaf mould, and 1 part of sand. The seedling pots or pans must be thoroughly drained, with moss or half-decayed leaves placed over the crocks, after which they may be filled up to within 1 in. of the top with the compost. A sprinkling of sand should be put on and pressed down level, after which it should be watered, and left to drain. The seed should then be sown thinly and covered with \( \frac{1}{8} \) in. compost—half-sand and half-soil. The seed pot or pan should then be placed in a warm part of the greenhouse, and covered with a piece of glass and also a piece of brown paper to prevent evaporation and the necessity
of watering until the plants have appeared. As soon as the plants appear, however, the brown paper must be removed. The condensed moisture on the glass must be wiped off and the glass replaced for a few days. A small stone should be put under one side of the glass to admit air. The pot or pan may then be placed near the glass to ensure sturdy plants being formed. Care is necessary at this time in watering, for too much water will cause every plant to "damp off" in a short time. When the seedlings are large enough to handle, they should be pricked out singly into small pots, using the same compost, but with about $\frac{1}{8}$ part of thoroughly decayed manure added. The plants may then be placed in a cool and airy part of the greenhouse, where strong, vigorous plants will develop; or when they have taken to the fresh soil they may be placed in a cold frame, if such is at hand, and given plenty of air and water when necessary. When the plants have grown considerably, one may be turned out of the pot, and, if the latter is filled with roots, the plants may be potted into their flowering pots, 5- or 6-in. pots being suitable for this purpose. By this time the plants will be growing rapidly, and will require a richer compost to grow in; it should consist of 6 parts of loam, 1 part of leaf mould, 1 part of well-rotted manure, and enough sand to keep it open. After this potting they should be placed in the frame again, given plenty of air and careful watering, until the pots are again filled with roots. Before frost sets in, the plants will require to be taken into the greenhouse, where heat can be turned on during frost. As the weather gets colder, and the days shorter, care must again be exercised in watering; otherwise the plants
may "damp off" at the neck. If flowers appear too early they should be nipped off, thus reserving the strength of the plants for the proper flowering season in early spring.

Cinerarias.—This is another class of plants which, when well grown, produce a splendid display in early spring. They flower very freely, while some of the blooms are of enormous size and bright in colour. Some of the varieties have smaller flowers, and are most useful for cutting for home decoration.

The seed may be sown during May, in a pot or pan, in a compost similar to that used for the sowing of Primulas; and, in fact, the sowing, and treatment in the very early stages, may be exactly as advised for Primulas. When they are large enough to handle they should be pricked off into small 60's pots, and placed in a cool, airy part of the house, and partially shaded. There is less fear of over-watering these plants. As the leaves grow, a large quantity of water is given off in transpiration, and this loss must be made good by the roots taking up more from the soil. When the small pots are filled with roots, but before they get potbound, the plants should be moved into 4-in. pots, again using the compost advised for potting Primulas. Some of the plants may remain in these pots to flower, but where extra large plants are required they may be placed into 7-in. pots, when the 4-in. ones are full of roots. When potted, they should be placed in a frame, if possible, or in a cool, airy part of the greenhouse, and the watering carefully attended to.

As already explained, there is not so much fear of over-watering these plants, but they must on no account get dry; otherwise they are almost sure to get attacked by
Greenfly; for this reason they should not be kept in a very dry atmosphere. If the latter is dry, some moss should be laid about these plants and kept damp. If Greenfly should get a start, the house should be fumigated with XL All Insecticide, &c., but if care is taken in watering the plants, and keeping the frames or greenhouse well ventilated, there is little fear of such attacks. When the pots are well filled with roots, and the buds are showing, liquid manure may be given. This may be made by putting about \( \frac{1}{2} \) bus. of fowl manure into a barrel sunk into the ground, and filling the latter with water; the contents should be well stirred and allowed to settle, when the liquid may be used. Another way of making the liquid manure is to put the fowl manure into a sack, and then slightly press it out into the barrel of water. This mixture is very strong, and will probably have to be diluted with clear water first. Afterwards it may be used at full strength, when the plants will greatly benefit by its use.

**Cyclamen.**—This exceedingly pretty spring-flowering plant deserves all the care it requires to bring it to a state of perfection. It is very easily raised from seed, some of which should be sown every year to ensure having a selection of strong young plants for flowering every spring. The seed may be sown in November, in a pot or pan thoroughly drained, and filled up to within 1 in. of the top with a compost of 2 parts of loam, 1 part of leaf mould, and a good sprinkling of sand; the top of this should be made level, then watered, and let stand for a time to drain, after which the seed should be sown thinly, and covered with about \( \frac{1}{6} \) in. of soil. The pot should be placed in a warm corner of the greenhouse, but as soon
as the seedlings appear they should be placed near the glass, to keep them sturdy. When the plants are large enough to handle, they should be pricked off singly into 60's pots, and again placed in a good position near the glass. Watering will have to be done carefully during the winter months, but as spring comes on more may be given. Early in summer it will be found that the pots are well filled with roots. They should then be potted into their flowering pots, only half-covering the corms with the soil; 5-in. pots will be very suitable for this purpose, using the same compost for this potting as for the last. The plants should then be placed in a frame. If this is fully exposed to the sun, they should be shaded during the sunniest part of the day. Watering will have to be regular, and plenty of air given on all occasions. The plants should also be syringed over in the afternoon; this will keep a nice growing atmosphere, and will tend to prevent the attacks of insects, Red Spider, Thrips, and Greenfly being troublesome if proper care is not taken of the plants. As autumn comes on, the plants should be taken into the greenhouse and given a nice light, airy position, and they should be carefully watered, and kept steadily growing until the flowering season in early spring. When this season approaches, more care in watering is necessary, or some of the flower stalks may "damp off".

**Calceolaria.**—This is another lovely flowering plant for the greenhouse for spring or early summer. Any quantity of these plants may be raised from seed very easily. Towards the end of July is the best time for sowing the seed. It should be sown in a pot or pan which has been thoroughly drained, using the same com-
post, and proceeding in the same way, as advised for Cyclamen. As the seed is very small, it must only be covered very slightly with soil, after which the pot or pan should be covered with glass and brown paper. The glass should be taken off and wiped occasionally to prevent the condensed moisture from dropping on the soil, and perhaps causing the young seedlings to "damp off" as soon as they appear. Immediately the seedlings are seen, the glass must be removed, and the pot or pan placed on a shelf near the glass, to ensure nice healthy, sturdy plants being produced. As soon as the plants are large enough they should be pricked off into 60's pots, using 3 parts loam, 1 part of leaf mould, \( \frac{1}{2} \) part of well-rotted manure, with a good sprinkling of sand; the pots should again be placed on a shelf near the glass, and carefully watered. When the pots are well filled with roots, the plants should be potted into 4-in. pots, using a similar compost, after which they should be placed on a cool, airy shelf again. When the pots are well filled with roots the plants may be moved into 7-in. pots, in which they will flower, using a compost of 3 parts of good
loam, 1 part leaf mould, 1 part of well-rotted manure, and enough sand to keep the whole open.

In potting, of course, there should always be a good space left at the top of the pots for watering the plants, from $\frac{1}{2}$ in. in 4-in. pots to 1 in. in 7- or 8-in. pots. During the winter, when the weather is more or less dull, and the days are short, care must be taken, in watering, not to give too much, or the plants will "damp off" at the neck. They must, however, never get dry, or they will be attacked by Greenfly and ruined. When the flower spikes make their appearance they should be staked, and some liquid manure given. The house should also be kept drier, to prevent the moisture condensing on the flowers and thus destroying them.

**Azalea indica.**—This pretty greenhouse plant deserves to be more grown than it is at present. Its habit of growth is somewhat different from that of most other plants, yet it is quite as easily cultivated.

The plants may be raised from seed, which should be sown in a pan thoroughly drained, using a compost of 4 parts of peat and 1 part of sand in a very fine condition. The seed, of course, must be sown thinly as soon as ripe, after which the pan may be placed in a warm place and shaded, to prevent evaporation. When the seedlings appear, the pan should be placed on a shelf near the light to prevent the plants being drawn, and thereby weakened. As soon as they are large enough to handle they should be pricked off into 60's pots, using a compost in the same proportions but in a slightly rougher condition, again placed in a warm spot, and watered cautiously. When the pots are full of roots the plants may
be moved into 4-inch pots, this time using 6 parts of peat to 1 of sand, or, if the peat is sandy, 8 parts to 1 of sand, again placing in a warm position and watering carefully. They may also be slightly syringed occasionally, to keep them growing and healthy. As growth proceeds, and the desired height is reached, the top may be taken out to induce side growths to form, which in turn may be stopped, forming a nice head or plant for flowering. They may also be potted into 6-in. pots, using the same compost. Always, when potting, remember to drain the pots thoroughly, as Azaleas will not grow satisfactorily in stagnant soil. They should have the soil slightly raised round the neck of the plant to prevent any possibility of moisture being retained there.

For the better varieties, however, it is generally advisable to graft the plants. Seedlings of common kinds may be raised, then good varieties grafted on them. The best method of doing this is to take shoots of half-ripened wood of the variety to be grafted. The seedlings also should be in a half-ripened state. Cut a part of the side of the seedling, or stock, about a third of the way into the shoot, then cut the scion to fit as nearly as possible on to the cut surface of the stock. The cambium of both stock and scion should join at least on one side (see particulars of grafting on page 260). The plant should then be tied with bast, &c., when in a short time a union will be effected. The plants should be kept in a moist, warm atmosphere, but the air must not be excluded, or they may "damp off".

In a small greenhouse (unless for a hobby) one would not think of raising a few plants either from seed or from
grafting. The plants can generally be bought very cheaply from the nurseryman, well set with buds or in flower.

We have now to turn our attention to keeping our plants in perfect health when obtained. To do this we must understand a few special points regarding them. 1. They do not like to be disturbed too often when once they are established, therefore potting should be done only once in two or three years. Porous sandy peat (for preference) should be used, or 3 parts of good fibrous loam, 1 part leaf mould, and from $\frac{1}{2}$ to 1 part of sand. The drainage of the pots must be good. 2. They must have plenty of water during the flowering and growing season, with less during the resting period. 3. They must have plenty of light and air always to ripen the wood and thus ensure the production of plenty of flowers.

The best time for potting is shortly after the flowering season, when growth is commencing. The roots will then enter the fresh soil, taking up the moisture and thus preventing injury being done by moisture being retained in it. Azaleas thrive best when potted firmly.

Thrips and Red Spider are the great enemies of these plants, but if the latter are carefully watered, and the greenhouse well ventilated, there is less fear of attack from these pests. For particulars of these pests see chapter XV.

**Dracænas.**—These plants, though not so showy as the plants previously dealt with, are yet the most useful of our greenhouse plants; they may be mixed with the other flowering plants, when their graceful foliage gives a free-
ness to the whole which cannot be obtained by using any other plants. The hardier varieties are most useful for room and table decoration. The soft green colour of their leaves does not clash with anything in the room, and the free arrangement of their foliage makes them ideal plants for the table.

Their cultivation is very simple. They can be raised very readily by inserting small pieces of stem with two or three joints in a sandy, peaty soil, with bottom heat. In a short time they will emit roots and produce a young shoot, which very soon grows into a nice plant. When they have made from 2 to 3 in. of growth they may be potted into 3-in. pots, which should be well drained, using a compost of 2 parts good fibrous loam, 2 parts fibrous peat, and enough sand to keep the whole open. They should be placed in a warm spot and watered carefully; they may also be syringed or damped occasionally. When the pots are filled with roots they may be moved into 5- or 6-in.
pots, using the same compost, after which they should not be repotted for two years unless large plants are required. They may be watered occasionally with liquid manure (weak to begin with). When they begin to lose their bottom foliage, and get rather a long stem, the head may be cut off and inserted as a cutting, or it may be rooted in a bottle of water and then potted in the usual way; or a cut may be made immediately under the fresh green leaves, three parts through the stem in a slanting direction upwards, a small piece of stone put in to keep the cut open. A handful of good moss may be tied under this, opening it out to form a cup, which should be filled with sandy peat, afterwards tying the moss all round and above the cut. The plant will soon emit roots if the moss and soil are kept moist by syringing, &c., and the roots will grow through the moss. It may then be cut off and potted in the usual way, to form a new plant.

When these plants are in rooms, &c., for decoration, they must have sufficient water, yet they must not be allowed to stand in water, as sometimes happens, or the tips of the leaves will die back. The same thing will happen if they are put in a draughty place. When these plants have been in rooms for some time, their leaves should be sponged occasionally to keep them quite healthy.

The Mealy Bug, Thrips, and Red Spider are the worst enemies of these plants. When Mealy Bug is noticed, the plants should be isolated and thoroughly cleansed with paraffin or methylated spirit. If it is a bad attack, the plants should be burned to ensure the destruction of this most terrible pest.
**Begonias.**—To this class belong some of the most showy of our greenhouse summer-flowering plants. There are many kinds, such as the strong-growing, climbing varieties, which grow up the walls of our greenhouses, &c., and produce large trusses of bright flowers; the many varieties of fibrous-rooted and free-flowering kinds; the beautiful-foliaged kinds; and the tuberous-rooted kind, which are familiar to all.

From the great variety of form noticed in these plants it will easily be understood that there are many methods of raising young ones. For the fibrous-rooted and climbing kinds, cuttings are generally taken. The points of young shoots, free from flower buds, may be taken at nearly any time, the leaves cut off the base, and a cut made clean through just below a joint. This should be inserted in a sandy soil in well-drained pots or boxes, and afterwards placed in a gentle bottom heat until rooted. When rooted, and growth has well begun, they may be potted into 3-in. pots, which should be well drained, using a compost of 3 parts of good fibrous loam, 1 part of leaf mould, with enough sand to keep the whole open.
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They should be placed in a warm position again for a few days, after which they must be put near the glass to ensure getting healthy, sturdy plants. When the pots are filled with roots the plants may be moved into 5- or 6-in. ones, using a compost of 4 parts of good fibrous loam, 1 part leaf mould, 1 part well-decayed manure, and \( \frac{1}{6} \) part of sand. Watering will have to be carefully done for a time until the pots are well filled with roots. When the plants come into flower, weak liquid manure may be given to assist them.

The ornamental-foliaged varieties may be raised in rather a curious way. If a large leaf is placed on sandy soil and pieces of stone laid on it to keep it quite flat, and the veins cut through at the joints, a small bud will soon appear where each cut is made. These will very soon develop into young plants, sending down roots into the soil and a shoot or shoots up into the atmosphere. When these little plants have developed, and are large enough to handle, they may be potted into 60's pots, having good drainage, using the same compost as advised for young plants from cuttings of the fibrous-rooted kinds. They should be placed in a warm position until the pots are filled with roots. The plants may then be moved into 4- or 5-in. ones, using the same compost as for older plants of the fibrous-rooted kinds. If large plants are required they may be potted into 6- or 7-in. pots when the smaller ones are filled with roots, using the same compost as before.

This kind is most suitable for room decoration, the beautiful large foliage being very attractive.

The tuberous-rooted kinds, which are amongst the
best of our showy summer-flowering greenhouse plants, are very easily raised from seed. From a small packet of mixed seed a great many plants may be raised of varying shades of colour. The seed should be sown early in March in a pot or pan well drained and filled to within 1 in. of the top with a compost of 2 parts sifted loam, 1 part of leaf mould, and a good sprinkling of sand. The surface should be made level, then watered, and allowed to drain, when the seed should be sown thinly (it is very small and requires careful sowing) and covered slightly with about \( \frac{1}{8} \) in. of the fine soil. The pot or pan may then be placed in a slight bottom heat and shaded to prevent evaporation. When the seedlings appear, the pot or pan may be placed on a shelf near the glass to ensure sturdy plants being formed. As soon as they are large enough to handle they should be pricked out into boxes 1\( \frac{1}{2} \) in. apart, or they may be potted singly into 60's pots, using the same compost as for seedlings. The loam in this case need not be sifted. The boxes or pots should then be placed on a shelf near the glass, again watering carefully. Any flowers which appear early should be nipped out. When these pots are filled with roots the plants should be moved into 5- or 6-inch pots, in which they may flower, using for their potting 4 parts of good fibrous loam, 1 part of leaf mould, 1 part decayed manure, and \( \frac{1}{6} \) part of sand. The pots should be well drained and \( \frac{3}{4} \) in. should be left at the top of the pot to ensure the plants being thoroughly watered when given. These plants require plenty of light, but they should be shaded from the direct rays of the sun. If space in the greenhouse is limited, many of the seedlings
may be planted out in a sheltered bed of good soil, and the best varieties marked, or lifted and potted for greenhouse culture.

For the best varieties the strain (or characteristics) must be fixed, that is, the plants must be isolated and the flowers carefully pollinated with pollen on a small brush and the seed sown for several years from young plants each year until the seedlings come true to the parents. The flowers must then be carefully watched to prevent them from getting contaminated with a useless sort. Cuttings may be taken of others by breaking some of the young shoots off the old tubers when they start in spring and potting them in the ordinary way as advised for fibrous-rooted kinds. For very rare varieties the tips of the shoots may be struck as cuttings, when with careful treatment in the second year they will make fair plants. The latter methods are not advised unless for very rare varieties, as they never make very fine plants.

**Fuchsias.**—These are some of the most popular of our greenhouse plants. They are easily propagated and very readily grown. Though lovely specimens from 6 to 9 ft. high, with perfect pyramids of lovely drooping blossoms, are seldom met with, yet we see very fine plants, especially at our village flower shows. In the larger establishments many new plants have been introduced which have encroached upon the space necessary to grow large specimens, but it will be a long time before they are superseded in the cottager's greenhouse or window.

Fuchsias are generally raised from cuttings taken in early spring. These should consist of the young shoots which have grown out after the resting period. Short
jointed shoots about $2\frac{1}{2}$ in. long should be chosen, the leaves being stripped off the base in the ordinary way. They should then be cut through with a very sharp, clean knife, just below a joint, and inserted round the rims of pots filled with a compost of loam, leaf mould, and sand in equal proportions, the pots being well drained. They may then be placed in a slight bottom heat or in a warm part of the greenhouse, where they will root very quickly. When rooted, they may be put up on a shelf near the glass and carefully watered, when growth will proceed steadily. When growth has well started they may be potted singly in 60's pots and returned to the shelf again, when, in addition to watering, they should be occasionally syringed or damped overhead with a water can during hot weather. Before there is any chance of the plants becoming potbound they should be moved into 4-in. pots, using a compost of 3 parts of loam, 1 part
of leaf mould, and enough sand to keep the whole open. By this time growth should be going on rapidly. If first-class plants are desired, no check must happen to the plants. When the side shoots make considerable growth they should have their tips pinched out to encourage a nice bushy appearance. The plants will have to be repotted before they become potbound, this time into 6- or 7-in. pots, using a compost of 4 parts of loam, 1 part of leaf mould, 1 part of well-rotted manure, and \( \frac{1}{6} \) part of sand. By this time the plants will have grown considerably, and the side shoots will have to be carefully pinched to form the nice pyramid shape. No more potting will be required during the first year, for by the time the 6- or 7-in. pots are filled with roots the growing season will be nearly over. The plants should be slowly ripened, water gradually withheld, and the atmosphere kept drier. On no account should they be allowed to become quite dry or they may be killed. Enough water should be given to keep the cells of the wood turgid. In spring the plants should be turned out of the pots, the soil well shaken off the roots, and the plants potted into smaller pots than they came out of, using the same compost as for the last potting. Water should be given sparingly until growth has well begun, and they may be regularly syringed. When growth has commenced, the plants should be gone over and any dead wood cut out. Branches not quite in the proper position may be tied into the right place to improve the symmetry of the plant. In a short time the roots will fill the smaller pots. They should then be potted into 7- or 8-in. pots and kept growing until flowering commences. Liquid manure may
be applied two or three times a week when this stage is reached.

There are many fine varieties now, from the beautiful single to the large double-flowering ones. They are very effective plants and well worthy of the care bestowed on them.

**Pelargoniums.**—This class of plants is well known to everybody, yet one seldom sees very fine plants, though so easily grown. There are several classes of Pelargoniums: (1) The show, or fancy kinds; (2) the zonals; (3) the ivy-leaved kind; and (4) the scented-leaved kind. All these may be treated in much the same way.

All may be propagated from cuttings of the young wood, which should not be too soft. Pieces about 3 in. long should be selected. The leaves should be cut off at the base, as should also the stipules. The slip should then be cut through with a sharp, clean knife, just below a joint, and inserted either in pots or boxes, well drained, and filled with a compost of equal proportions of leaf mould and sand. The pots or boxes should be placed in a frame where the lights may be thrown off when the weather is dry, or placed in a light, airy part of the greenhouse. On no account must they remain in a close or damp atmosphere, or they will damp off readily. If the weather is dull after the cuttings are taken, some of the leaves will usually "damp off", and these must be removed at once; otherwise the fungus may spread to the stem of the cutting, and even to other cuttings. Consequently, if neglected, whole boxes or pots may be lost. To prevent this, it is better to take the cuttings early enough—about the end of August—to ensure their being rooted
in the autumn before the short, dull days come round. If cuttings of young shoots are taken in spring, they will root very readily in a little bottom heat. When they have made a little growth, showing that they are well rooted, they may be lifted out of the cutting pots or boxes and potted singly into 60's pots. The compost which should be used for this potting should consist of 3 parts of good fibrous loam, 1 part of leaf mould, and $\frac{1}{10}$ part of sand. After potting they should again be placed on a shelf near the glass, in a sunny and airy position. It must be remembered that the wood must be thoroughly ripened if these plants are to flower freely. Watering should be carefully attended to until the roots have taken to the new soil. As growth proceeds, the plants will soon require to be repotted, this time into 4-in. pots, which should be well drained, using a compost of 4 parts of good loam, 1 part of leaf mould, $\frac{1}{2}$ part of decayed manure, with enough sand to keep the whole open. After repotting, they should be placed in a similar position with regard to light and air, giving considerably more room this time to allow the plants to develop. Careful watering is required for a time, especially after repotting. Before the plants have time to get root-bound in the 4-in. pots they should be moved into their flowering pots; 6- or 7-in. pots will be a convenient size for this purpose. The compost this time should consist of 3 parts of good fibrous loam, 1 part of well-rotted manure, and a sprinkling of sand. A 5-in. potful of bone meal may be added to every bushel of soil. The pots should be well drained, and the soil should be made very firm with a potting stick round the ball of the plant; this will tend to check
its growth and increase the number and quality of the flowers. A space of at least $\frac{3}{4}$ in. should be left at the top of the pot for watering. When the plants come into flower they will derive great benefit from the application of liquid manure once or twice a week.

The above description, though applicable to all kinds of Pelargoniums, is especially so to zonals and fancy kinds. The ivy-leaved, and Cape or scented-leaved kinds are often flowered in smaller pots, 4- to 5-in. only.

Pelargoniums lend themselves very readily to various methods of training. We sometimes see beautiful specimen plants in various shapes. The zonals are often trained on wires to represent a mushroom, or a single stem is run up for 3 ft., and a flat head formed, resembling an umbrella. These, when covered with bloom, look very attractive. They are also trained as standards, with the single stem and an ordinary head, without tying down. They may also be trained in the shape of a fan if desired for a special purpose.

The ivy-leaved kind is trained in a variety of ways; sometimes simply against the wall of the greenhouse, when its dark-green foliage and, in season, its large number of flowers make a very fine effect. It is frequently trained as a pillar, by placing a few stakes round the pot and tying the long, trailing shoots round them. When the plant has made sufficient growth to cover up the stakes, and has bloomed, it looks extremely well. The most popular method of training these plants, however, seems to be in the balloon shape. A wire framework in the shape of a balloon is procured and placed on the top of the pot. The young shoots are then trained over it.
When this is covered with shoots, and well in bloom, it presents a very pleasing appearance. All these forms of training have a very artificial appearance, and this to some extent minimizes the true effect of such a plant. Ivy-leaved kinds may also be left trailing over the staging.
of the greenhouse, &c. The Cape or scented-leaved kinds are generally grown quite naturally,

**Campanula isophylla alba.**—This pretty little trailing plant is well worthy of a place in the greenhouse. Its slender drooping stems, small round leaves, and masses of pure-white flowers unite in making it a most valuable plant.

It is propagated very readily by cuttings. After flowering, the plants may be cut over, when they will very speedily send up large numbers of young shoots from the crown of the plant. When about 2 in. long these young shoots may be taken off to make cuttings. The leaves at the base should be cut off, and the shoot cut through just below a joint with a clean, sharp knife. In the meantime a compost of sand and leaf mould in equal proportions should be made up, then well-drained 4-in. pots should be filled to within \( \frac{1}{2} \) in. of the top with the compost, the latter made firm, and the cuttings inserted 1 in. apart round the side of the pots. They may then be placed in some shady place, when rooting will very soon commence.

When the cuttings have made some growth, and have rooted well, they may be potted into 4-in. pots. Thus a 4-in. potful of cuttings may be divided into three clumps or plants. The soil or compost used for this potting should consist of 3 parts of good fibrous loam, 1 part of leaf mould, with enough sand to keep the whole open or porous. After potting, the plants should be placed near the glass to keep them sturdy. They must be shaded on bright days, and watered carefully until the roots have started well into the new soil. As growth proceeds it
will be found necessary to move the plants into larger pots, 6-in. ones being suitable for flowering. The compost for this potting should consist of 3 parts of good loam, 1 part leaf soil and manure, with enough sand to keep the whole open. They should now be exposed to all the light possible, avoiding the direct rays of the sun, to ensure the stems being well ripened for flowering. From their trailing habit of growth these plants will always have to be grown in the front of shelves, stages, &c., or they may be grown very effectively in hanging baskets. The method adopted by cottagers for growing this plant is to pot in the usual way, then place the pot on a board suspended in the window. In greenhouses they may be planted in wire baskets. These should be first lined with moss, and some soil placed on it. The plants should then be put on this soil, and the basket filled nearly to the top with the compost well firmed round the roots. These baskets must be plentifully supplied with water. They are suspended by wires from the roof of the greenhouse, and are a charming addition to it.

The blue variety is also a beautiful plant, and may be treated in the same manner.

**Greenhouse Ferns.**—These are among the most useful of our greenhouse plants. Though not producing bright flowers, they possess a beauty all their own, and should always be cultivated where space can be found for them.

Most Ferns, greenhouse or otherwise, like a shady and moist place in which to grow, unlike other greenhouse plants which require as much sunshine as possible to
ripen their wood. In every greenhouse a shady corner may be found where a few at least of these useful plants may be grown. Ferns are easily reared when given the few essential conditions necessary.

If we turn to their natural habitat we at once see of what these conditions consist. Ferns are usually found in woods, hedgerows, &c., under the shade of other plants. In such places the soil is made up to a considerable extent of vegetable matter, such as leaves of trees, decaying roots of grass and other plants. The atmosphere is more or less moist, and as the sun's rays cannot penetrate directly to the soil, evaporation goes on very slowly. The soil cannot be waterlogged in such places, as the roots of trees take up large quantities of water, and much of that which is left drains into the ditches. This assists us in arriving at the proper treatment of Ferns under the somewhat artificial conditions of the greenhouse.

If we start the cultivation of these plants from the beginning—that is, from spores, which correspond to the seed of flowering plants, they will require very careful treatment until fully started. The spores are very small, and require careful handling. The Fern plant is not produced directly from the spores, but in the following manner: On germinating, the spore produces a prothallus, on which the sexual organs—anteridia (male); archegonia (female)—are formed. When these are matured, a spermatozoid from an antheridium effects the fertilization of the ovum of an archegonium, and from this fertilized ovum the Fern plant is produced.

These prothalli are very small, a large one measuring
only $\frac{1}{4}$ in. The spores must be sown thinly, in soil made of 2 parts peat, 1 part leaf mould, 1 part loam, and $\frac{1}{6}$ part sand. Before sowing, the soil must be sterilized—that is, heated to 212° F., the boiling-point of water. This is done to kill any algae that may be in it, as these would multiply rapidly and prevent the development of the prothalli. The spores should be sown in a pan, well drained and filled with the above compost, and should not be covered with soil, as the prothalli are produced only on the surface. They should then be placed in a close, moist atmosphere, and shaded. A box covered with glass, or under a bell glass, &c., is suitable for this purpose. Care must be taken not to allow any condensed moisture to drop on to the soil, either before or after the prothalli are formed, as this would cause them to “damp off”. A moist atmosphere is required, as fertilization is only effected under water, but the slightest quantity is sufficient for this purpose.

When the young Fern plants are large enough to handle, they should be pricked out into other pans filled with a similar compost to the above, and placed about 1 in. apart each way. They must again be placed in a moist, warm atmosphere, and shaded. As growth proceeds the young plants may be potted into 60's pots, using the same compost again. At this stage the Fern plants are most useful for room decoration.

As growth continues they may be moved into 4-in. pots, and again into 6-in. ones, which should be large enough unless specimen plants are required. For the latter potting a compost of 2 parts of peat, 1 part of leaf mould, 2 parts of loam, and $\frac{1}{3}$ part of sand should be
used. It is not advisable, nor necessary, to pot full-grown plants every year. Some may go for two or three years, but they must be assisted by weak liquid manure during the growing season. A little soot added to the manure water is found to benefit ferns greatly. Some of the ferns suitable for greenhouse culture are—

Adiantum decorum.  
Asplenium bulbiferum.  
Asplenium caudatum.  
Blechnum latifolium.  
Davallia canariensis.  
Gleichenia dicarpa.  
Polypodium pectinatum.  
Pteris cretica.  
Pteris tremula.  
Woodwardia radicans.

Chrysanthemums.—This is one of our most valuable classes of greenhouse plants. Though grown for a considerable time in the open air, yet they require the protection of the greenhouse. They come into flower at a time of the year when most of the other plants have finished flowering for the season.

They are propagated by cuttings, the young shoots which are produced from the root at the base of the stem being most suitable for this purpose. These may be taken when the plants have finished flowering. Short-jointed ones about 2 or 3 in. long should be chosen. After taking off the leaves at the base, and cutting them through with a sharp knife just below a joint, they should be inserted round the sides of small pots, which have been well drained and filled with a compost of sand and leaf mould in equal proportions. Four or five may be put into a 60's pot. The pots may then be placed in a cool propagating case or in a box covered with glass and paper to prevent undue loss of moisture until rooting has taken place. When they have rooted well, they may
be potted singly into 60's pots, using a compost of 3 parts of loam, 1 part leaf mould, and enough sand to keep the whole open. They should then be placed on a shelf near the glass, to ensure nice sturdy plants being formed from the first. Growth will now go on rapidly, and in a short time it will be found necessary to move the plants into 4- or 5-in. pots, using a compost of 3 parts of loam, 1/3 part of leaf mould, 1/2 part of well-rotted manure, and a sprinkling of sand. The plants may then be placed in a frame, and, if required as decorative plants or for cut flowers, they should be cut over to within 6 in. of the pots, after they have taken to the new soil, when they will soon form three or four nice shoots. Watering should be carefully done and the plants damped over occasionally, using the rose on the watering can or the syringe. The final potting should take place from the middle to the end of June, using 8- or 9-in. pots, and a compost of 6 parts of good fibrous loam, 1 part leaf mould, 1 part of well-rotted manure, with a good sprinkling of sand and wood ashes, and a 5-in. potful of bone meal to each bushel of soil. The plants should be firmly potted, using a potting stick, and enough space (1 to 1 1/2 in.) left at the top for watering. The plants may now be placed outside in a nice sunny position, where the wood will get thoroughly ripened during growth. If they have made satisfactory growth, and no appearance of breaking naturally, they may be cut over again, leaving from 6 to 8 in. of the young shoots, which will soon form nice bushy plants. When the flowering pots are well filled with roots the plants should be given liquid manure once or twice a week. This must be weak
at first, but as the flower buds appear it may be increased in strength. Staking, of course, will have to be attended to as growth proceeds, and if the position where the plants stand is exposed to wind the stakes should be tied to a wire stretched along the row of plants nearly as high as the stakes.

As autumn advances, before there is any danger of injury from frost the plants must be taken into the greenhouse, allowing them plenty of room and a good supply of air, or mildew is sure to make its appearance. If mildew does attack the plants it should be stopped at once by sprinkling sulphur on it, or by using Ewing's Mildew Composition, &c., and ventilating more carefully.

**Roses.**—Many of these charming plants are suitable for growing in the greenhouse, and can be used in a variety of ways, for training on the roof (climbing Roses), or as ordinary pot plants, &c. They are generally propagated by budding or from cuttings, a full explanation of which is given in the following chapter. The soil used for roses should consist of 6 parts of good fibrous loam, 1 part of leaf mould, 1 part well-rotted manure, with a sprinkling of sand and wood ashes. They should be potted into 8- or 9-in. pots, which should be thoroughly drained, leaving 1 in. of space at the top to ensure thorough waterings. Potting may be done in the autumn and the plants plunged into a bed of ashes outside for the hardier sorts, and covered with a layer of manure to protect them from frost. For the more tender kinds, however, the protection of a cold frame is required. In spring they may be lifted, pruned, and taken into the greenhouse, where they will soon break. The pruning
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should be carefully done, thinning out all weak shoots, and cutting the stronger ones well back to keep the plants within reasonable bounds. This subject has been fully dealt with in chapter VII. Water will have to be judiciously given to begin with, and plenty of air admitted to ensure a healthy growth and prevent attacks of insects or mildew.

As growth proceeds, and the plants come into flower, manure water may be given once or twice a week. Of all insects, Greenfly is the greatest enemy to the Rose. Should this pest make an appearance, the house must be fumigated with XL—All Insecticide, &c.

Mildew is the most troublesome disease, and should be immediately dealt with. Ewing's Mildew Composition is very effective, or, if the attack be only a slight one, sulphur dusted well into it will check it.

It is not advisable to cover the roof of a small greenhouse with Roses, as plants growing under them do not have a good chance to develop.

**Tomatoes.**—A few of these plants may be grown in any greenhouse, and will produce a quantity of most wholesome fruit if properly managed. But where flowering and other plants are the main feature of a small structure too many Tomato plants should not be grown. A few placed in such a position as not to interfere with the healthy growth of the other plants are quite permissible. The back wall of a lean-to house, or against the glass end of a span-roofed house towards the north, are good positions. The plants will then get the full advantage of the sunlight, and will not shade other plants in the house.
Tomatoes are very easily raised from seed. This should be sown in a pot or pan towards the end of February, using a compost of 2 parts sifted loam, 1 part of leaf mould, and a little sand. A piece of glass and paper should be placed over the pot to prevent evaporation. In a short time the plants will appear, when the glass should be removed and the pot or pan placed on a shelf near the glass, to ensure sturdy plants being formed. As soon as the plants have made two rough leaves they may be potted up singly into 60's pots, using a similar compost, and placed on the shelf again. They may either stay in these pots until ready for potting into their fruiting ones, or they may be put into 5-in. pots, using a similar compost, with the addition of $\frac{1}{2}$ part of well-decayed manure. It is always well to remember when growing Tomatoes that it is fruit that is required, and not large, strong plants, and to treat them accordingly. If they are given very rich composts to begin with they are apt to develop rank growth, but if given just sufficient food for their ordinary requirements they become fruitful.

A good time for potting them into their fruiting pots is when the first truss of flowers is produced; 12- or 14-in. pots are a suitable size. These should be well drained. The soil for this potting should consist of 6 parts of good fibrous loam, 1 part leaf mould, 1 part of well-rotted manure, and a good sprinkling of wood ashes and sand, with a 5-in. potful of bone meal to each bushel of soil. When potting, it is advisable to half-fill the pots with soil, the other part being added as a topdressing when the plants have made considerable growth. The soil must be made very firm with a potting stick. When the roots have
filled the pots, plenty of water is necessary, and when a few trusses of flowers have set on each plant, liquid manure may be given freely to assist in swelling the fruit. As the plants grow, care must be taken to remove any side shoots which make their appearance, as a side shoot immediately above a truss of flowers may receive practically all the food which should go to the formation of fruit. When the plants have set as many bunches of fruit as can be ripened before the cold and sunless days come on, the tops should be taken off, that all the energy of the plant may be utilized in swelling and maturing that already formed. It may also be advisable to take off some of the foliage to enable the sun to get at the fruit and assist in ripening it, but this should not be done to any great extent, as it is in the leaves that the food is manufactured for the formation of fruit, &c. Therefore, only those covering the fruit should be taken off.

Of course, in a small greenhouse, where other plants are of the first importance, it is not possible to cultivate a large crop of tomatoes, but with judicious treatment a nice crop may be obtained, which will fully repay the care bestowed on it. The plants lend an additional charm to the greenhouse and the garden generally.

THE GARDEN FRAME

No garden should be without this most useful and inexpensive structure. There are many plants which require some protection during winter, yet do not require heat, such as the Calceolarias, &c. Again, there are many of our half-hardy annuals which require the protection of a
frame for a time, such as Stocks, Asters, &c., while with regard to vegetables, we may harvest some of them quite a month earlier if a frame is at our disposal. This applies to Lettuce, Cauliflower, Celery, &c. It is even possible to grow some early vegetables altogether with its aid, by making up a hotbed with two or three cart-loads of fresh horse manure and, if possible, about a cart-load of leaves, mixed together and thoroughly heated. This should be built up into a heap about 6 in. larger than is required, all round, treading it firmly during building, so that it will give up its heat slowly. The frame should now be put on the top of this, and 9 in. to 1 ft. of ordinary garden soil put into it, and allowed to settle for a few days. Early stump-rooted Carrots, early Turnips, Lettuce, Radish, &c., may then be sown in it. The heat rising from the manure below, with the sun heat on the glass, will bring such crops on very quickly, and as they come early in the season they are much appreciated. A frame may also be utilized during the summer for growing Lettuce, Mustard and Cress, young Carrots, Turnips, &c., which are all superior in flavour when they can be gathered in a fresh young state.

CHAPTER X

Propagation

Propagation is the most important department of gardening, and requires a great amount of patience and perseverance.
Nature's great method of propagation is by seed, and some plants must be raised in this way, such as annuals and biennials. To get plants to come true in every characteristic to the parent plant from seed requires much careful work in selecting the plants each year, and fixing those characteristics. A detailed explanation of this will be found in chapter XI.

Propagation by seed is, of course, the best method, but as this method requires a long time for the plants to mature, it is found more convenient to propagate many of our plants by other and quicker methods, such as by cuttings, layers, division of rootstock, suckers, budding, and grafting.

Having treated the subject of propagation by seeds at some length in chapter III, it is not proposed to deal with it further here.

**CUTTINGS**

After seeds, propagation by cuttings is the most general method of increasing plants. There are many different ways of taking cuttings, to suit the many different kinds of plants in cultivation, a typical one being to take about 3 in. of the point of the shoots, cutting off the lower leaves, and cutting through just below a joint with a sharp, clean knife, and inserting in sandy soil about 1 to 1½ in. deep. The cut end will soon heal over, and roots will be emitted from the healed parts.

Chrysanthemums, Pelargoniums, Violas, Pansies, Pentstemons, &c., may all be propagated by cuttings in this way in the autumn. Others may be taken in spring; the young shoots which have made from 2 to 3 in. of growth may
be taken off and treated in the same way as advised above, and inserted in sandy soil. Most of such cuttings like to have more or less bottom heat to make them heal over and send out young roots quickly. Such plants as Fuchsias, Lobelias, Ageratum, &c., may be treated in that way.

Other plants require very different treatment: the shoots require to be ripened, and pieces of considerable length, from 10 to 12 in., should be taken. The softest part of the point, and also the hardest part at the base of the shoot, should be cut off with a sharp knife, just below a joint, and in the case of Gooseberries and Red Currants the buds should be rubbed out all but three or four at the apex.

In Black Currants they should be made to produce a rootstock rather than a bush on a main stem. This kind of cuttings may be taken during the winter, heeled into moist sand, and planted in the open ground very early in spring. The method which should be adopted in planting the cuttings is to make a good deep niche with the spade, 9 in. deep, quite straight down at the back, then put 2 in. of sharp sand in the bottom, and plant the cuttings perpendicularly, 3 in. apart, the base resting on the sand. Put in an inch or so more sand round the base of them, then fill up with soil, and tread firmly. The line may then be laid down 12 in. from the last row, another niche made, and so on.

At the end of the first season the cuttings may be lifted and planted 12 in. apart in the rows, with 18 in. between the rows.

Some cuttings will root well in bottles of water.

If the tops of Dracænas are cut with a sharp, clean
knife, some of the leaves taken off, and then placed in water, they will root readily. Afterwards they may be carefully removed and potted. It must always be borne in mind that the base of the cuttings, in whichever way they are made or put in, should always rest properly on the bottom of the hole, if they are put in with the small dibber, or in the sand, or if put in a niche made with the spade. If the cuttings are hanging in the hole, they will never root satisfactorily. This must also be thought of with reference to cuttings put out in the open ground. After a frost and thaw, which lifts up the surface soil, and the cuttings with it, it is advisable to go over the bed and fix them down. Otherwise they will be left hanging in the holes, and will not root. Some cuttings, such as Pelargoniums, will root better if they are exposed to the sun. Others require to be shaded for some time, such as Calceolarias, &c. Others not only require shade but also need to be covered with a bell glass or hand light to prevent evaporation until they have taken root, such as the Ericas, &c.

Sometimes it is found better to take the cuttings with a heel, that is, with a small portion of the wood of the older branch attached to them. Roses do very well in this way, and may be treated in the same manner advised for Gooseberry and Currant cuttings. If they are inserted in the autumn it is a good plan to mulch the ground, as it were, with half-decayed leaves, putting on 6 or 7 in. This will prevent the frost acting on the soil and lifting up the cuttings in the holes.
BUDDING

Budding is a very popular way of propagation, especially for Roses and fruit trees, &c. It is very simple if the essential details are attended to.

To begin with, the buds must be of sufficient size, yet not too far advanced, and the wood must part very freely from the bark. Then the stock, or plant in which the bud is to be inserted, must be in proper condition, so that the bark will part freely from the wood. The conditions are generally found to be most suitable from the middle of July until the beginning of August. The shoots should be selected with the buds intended to be taken off and inserted in the other plant. They should be nice and plump, but not too far advanced. Some at the base of the shoots will be found to be too matured, while those at the apex will not be matured enough. A good sharp budding knife, if possible, should be used, and the bud selected should be cut out by inserting the knife $\frac{1}{2}$ in. below the bud, cutting through about a third of the shoot, afterwards cutting upwards about $\frac{3}{4}$ in. above the bud. The wood should then be very carefully removed by inserting the point of the knife at the bottom, lifting up the wood from the bark, and taking it between the thumb and the blade of the knife and jerking it out, taking care not to destroy the base of the bud. If there be a nice green little cushion opposite the bud it is all right, but if a little hole is there instead, the bud is useless, and will not grow.

A little practice will soon make one able to take out the wood and leave the base of the bud every time. Some people take the wood out from the top, others from the
Propagation

side, and still others from the bottom. It matters little if the base of the bud is left. It is best, however, to practise on some worthless shoots (in the proper condition), and not to be disappointed if success does not crown the first efforts. Perseverance will soon bring success.

When a correct bud is obtained, the rest is very simple. For bush Roses on the Brier stock it is advisable to earth up the plants a week or so before budding is to take place. This will keep the bark soft and allow it to part from the wood more readily. The soil may then be drawn away with the hands and a cut made straight up the centre of the shoot just as deep as the bark, about 1 in. long. Afterwards a cross cut should be made at the top, thus forming a T cut. If a budding knife is used with a flat handle and sharp end the bark should be lifted up with the point of the knife at one side and the end of the handle inserted and run down, lifting the bark the whole length of the cut from the wood on both sides. The bud, which has been previously prepared, should be kept between the lips, so that the breath may keep it moist until required. It should then be caught by its sides, and the end of the bark should be inserted at the cross and slowly slipped down between the wood and bark, taking care to keep it well inside the cut on both sides. When it is partly inserted, the petiole of the leaf in the axil of which the bud was formed should be held.

With half of the leaf, press downwards until it is nearly
all inserted in the T cut. Then a small part of the bark, with the bud attached, should be cut off along the cross cut of the T, thus leaving the cut ends of the two barks close together. These will unite and make a close union. When this is done, the bud should be tied into position with bast, placing the end along the back of the shoot and leaving enough at the top to tie. The bast should then be closely rolled round the joint, and tied behind it at the top. There are other ways of tying. One is to cut the bast into the required length, double it, form a loop by putting it round the shoot with the bud, and through the loop draw it up firmly with one of the strands above the bud and one below. Then roll the one end downwards and the other upwards until the cuts are covered. Then give a turn or two round again until the two ends meet at the back opposite the bud, and tie. In this method care must be taken not to pull the loop too tight, or the bud will be strangled.

The principal object aimed at in tying is to keep the bud in position and the bark together, to allow the healing process to go on rapidly. It matters little which way it is done so long as this object is attained. Care, of course, must be taken not to tie too tightly and not to let the tying material go right over the bud. The buds should be looked over occasionally, and as soon as the union seems to have taken place, and a slight swelling is noticed, the ties should be removed. If the healing is not complete, fresh ties should be put on for a time.

The stocks should be partly cut back after the buds have taken, but they should not be cut back to the bud until just before growth commences in the spring.
STANDARD APPLE TREES EIGHT YEARS OLD
Other methods of budding, such as square budding, ring budding, &c., are sometimes adopted, but the T or shield budding is the most convenient, and this explanation of it should suffice for a work of this kind.

Stocks for budding roses are the Manetti for dwarf bushes, and also the seedling Brier for the stronger-growing varieties. For standards the common Brier of the Dog Rose is best.

The Wild Gean and Seedling Morello are suitable for the Cherry; the Mussel, St. Julian, &c., for the Plum, Peach, and Nectarine, and also the Apricot. The Crab and Paradise are stocks for the Apple; the Quince for Pears.

When fruit trees have been budded and the buds have not taken they may be grafted the following spring.

**GRAFTING**

This is an operation even more delicate than budding, as you have to get the cambium (or actively growing tissue) of at least a part of the stock and scion to come together so that a thorough union takes place. This cambium is the layer of tissue just inside the wood under the bark of all dicotyledonous plants. It is in this dividing tissue that all the other tissues of the plants originate, and it is this cambium which forms the tissue to heal over the base of a cutting when it is planted, and also forms the tissue to heal all wounds on the plants.

Now, when a piece of one plant is grafted on to another plant, and part of the cambium of the one comes into contact with part of the cambium of the other, active growth
commences on both sides, and a union is very soon effected. If, however, the two layers of cambium tissue do not come into contact at any point, no union is possible, and the graft will not take.

This cambium layer being in the same position in all plants of the same kind, it is not necessary to know where the layer is exactly, but if the bark of the stock (the plant on which the graft is to be put) and the bark of the scion (the part of the plant which is grafted on to the other plant) are exactly opposite, at least at one part, a union will take place; but the more the two barks, and consequently the two layers, come together the better will be the union. This should always be carefully borne in mind when grafting is being done.

The most effective and one of the simplest methods of grafting is the "whip" or "tongue". It is generally used when both the stock and scion are about the same size, therefore for grafting on seedlings. When everything is in readiness the scion should be cut through obliquely with a sharp knife, and then a tongue should be formed by making a cut in the opposite direction from about one-third of the length of the cut from the end, right into the shoot. After this, without any delay, the stock should be cut through in a corresponding manner, and then another cut should be made downwards to correspond exactly with
the tongue of the scion, into which this tongue should be placed, and gently pushed down into its proper position, taking care to have the barks, and therefore the cambiums, fitting properly as much as possible. They should then be bound over firmly, but not too tightly. The whole should then be painted over immediately with grafting wax, or with clay, to exclude the air, and prevent the cut parts from drying up.

Worthless shoots should be practised on for making the cuts to fit properly in as short a time as possible. Much depends on the length of time taken in grafting, as well as on the way it is done, for the measure of its success. If the tissue of both stock and scion is nice and moist, a union is effected much sooner.

There are many other ways of grafting, such as cleft grafting, where a cleft is made in the top of the stock. This may be larger than the scion. A wedge-shaped end on the scion should be made, and slipped into the cleft, the one side of the scion fitting exactly with the bark of the stock. Two scions may be put into one cleft if the stock is larger than they are. It is not such a good method, however, as it takes so long to heal up the centre of the cleft.

Saddle grafting is another method, and consists in making a wedge-shaped end on the stock and cutting a V-shaped portion out of the scion to exactly fit on to the top of the stock. If the stock is too large, one side should fit again.
Wedge grafting consists in making a V-shaped cut in the stock, and making a wedge-shaped end on the scion to fit exactly into it.

Grown or ring grafting is performed generally on older trees, and consists in putting one, two, or more scions on an older tree, the top of the tree having been cut off a month previous to grafting. At grafting time, cut a little farther back, so as to have the cuts fresh. Then the scions are prepared by making a notch at the top where the oblique cut is to be made. The pointed end of the scion is then slipped between the bark and the wood until the notch rests on the top of the cut end of the stock.

Side grafting may be performed where it is not desirable to cut away the whole top of the tree, but where a branch has been injured, &c. It consists in taking a scion, making a notch, and then an oblique cut from this outwards, afterwards making a notch and cut to correspond on the stock, then putting the two together exactly, and tying up, covering with grafting wax or clay.

Approach grafting. — The scion to be used in this case must be rooted and movable (in a pot, &c.). At the time of grafting this plant may be brought and placed beside the plant to be used as a stock. Then a small slice may be taken off both stock and scion and the two brought close together—the cuts exactly corresponding—tied up, and covered with grafting wax. This method of grafting should be done when the leaves are on the trees.

Herbaceous grafting is another form which can be
made extremely interesting, by grafting a Tomato plant on to a Potato, or a Melon on to a Cucumber, &c. The above examples are done more as a curiosity than for any useful purpose.

*Root grafting* is another rare form of grafting. Dahlias, Tree Pæonies, Clematis, Hollyhocks, &c., are sometimes propagated in this way. It consists in selecting good roots as stocks and cutting a V-shaped cut about \(1\frac{1}{2}\) in. deep in them, preparing the shoot by cutting a wedge-shaped end to it and fixing it into the root, tying it up, and covering with grafting wax until the union is effected. They must be shaded for a time from the sun.

**Grafting Clay.**—This consists of 2 parts of clay, 1 part of cow manure, and a little finely cut hay. The latter is to bind the clay together, to prevent it cracking and falling off. The whole should be mixed up some time before it is to be used, and occasionally stirred before using. It may be kept soft by making a hole in the centre and filling it up with water.

**Grafting Wax.**—This is more convenient for use, and for delicate plants is almost indispensable. It is sometimes made up of resin, beeswax, and tallow, and used lukewarm; or it may be bought ready for use and suitable for using cold.

Grafting may be performed any time when the sap is in motion, but the hot weather of midsummer should
be avoided. It is largely practised in spring both for indoor and outdoor plants. The length of the scion should be about 6 in. The growth of the shoots for fruit-tree grafting may be retarded by cutting them off and heeling them into moist sand or soil in a cool place. As has already been noticed, a great deal depends on the quickness with which the operation is done, the exact fitting of essential parts of the stock and scion, and the cut being made with a clean and very sharp knife. The latter will prevent the cells of the stock or scion being bruised, and thus retarding the healing process. Double grafting is sometimes practised. When it is found necessary to have good strong roots for certain soils, such as the seedling Pear, it is sometimes found that some of the more delicate-growing varieties do not succeed well when grafted directly on to the strong-growing seedling plants. Then the Quince may be grafted on the seedling Pear, after which the finer-growing varieties of Pears may be grafted on to the Quince with success.

**Layering**

This is another popular method of propagating some plants, such as Carnations, &c. In Carnations this consists in first of all scraping away the soil to a depth of 1½ to 2 in. round the plants, then filling up the gap made with sandy soil, afterwards selecting the shoots to be layered. The leaves should be taken off, with the exception of a few at the apex. Then, with a sharp, clean knife, make a cut halfway into the shoot, and right up through the centre of the shoot, through at least one
Propagating by Circumposition

Joint. The cut should be kept open by a tiny stone or small piece of wood. The shoot should then be bent and pegged down into the sandy soil. Pieces of bracken fronds, cut to act as hooks, or wire pegs may be used to keep the shoots in position. The whole should then be covered over with 2 in. of sandy soil, leaving a circle of what will appear like cuttings round the old plant. They are better than cuttings, because they are supplied with moisture and food substances by the parent plant until they have formed roots. In dry weather the layer should be watered regularly.

Layering may be done during the last fortnight of July, or early in August. The young plants may be lifted and planted in their permanent quarters in the autumn. They may be kept attached to the parent plant until the spring, if the gardener wishes. Many other plants are propagated by means of layers, such as Azaleas, Rhododendrons, &c. This is done in a variety of methods:
1. By ringing; 2. twisting; 3. notching. They have all the same aim in view, viz. to arrest the flow of sap and induce the formation of roots at the points where the interruption of the sap has taken place.

Sometimes layering is effected by notching, or making an oblique cut partly through a stem, through a joint, and fixing a flower pot (which has been carefully halved) round the stem. Sandy soil should be used and the plant tied securely to a stake and kept watered. This may be done even though the branch is a considerable distance from the ground.

Dracaenas are propagated by making a cut into the stem, keeping it open by a small stone, then tying some moss round below the cut part, and forming a cup round the cut with the rest. This may then be filled up with sandy soil and moss tied firmly all round. If this is kept syringed the roots will soon be emitted. They will be seen growing through the moss. The tops may then be cut off and potted.

**SUCKERS**

This is another form of propagation which is sometimes adopted, and consists of taking a shoot which has been produced from the base of a plant, under the soil, with a piece of root attached to it. A sucker produces a plant more quickly and surely than a cutting. There is, however, one drawback to the method; the sucker produces suckers freely itself. This sometimes becomes a source of trouble if the bushes are planted in borders, as the suckers are sometimes sent up some distance from the plant. The Lilac is frequently propagated by suckers.
Sometimes fruit trees are budded or grafted on suckers. This is not a good plan, however, owing to the trouble caused by the constant growth of suckers.

DIVISION

Propagation is generally effected by division, among the majority of herbaceous plants. It is done in the springtime, just when the plants have started growth. The thick fleshy roots (in many cases) soon heal up at this time.

If the clumps are large, a spade may be taken and the clumps cut up with it. A fork should then be used for lifting out the pieces. If they are comparatively small, they may be cut with an edging iron, which will be sharper than a spade. On no account should the healthy parts of the clumps round the outside be all cut off. If this is done, the older exhausted part would be left to form the plant for the following year. This is often done by those who ought to know better. The plant should be carefully divided, and, if necessary, the old plant should be thrown away entirely, and replaced by a young healthy one.

It very often happens that the clumps of herbaceous plants become too large. This reduces their strength. The flowers, too, become smaller than they should be. Plants should always be divided before they become too large.
CHAPTER XI

Hybridization and Crossbreeding

This is one of the most interesting and most important operations of gardening. What patience and perseverance one must have to carry on such fine work! Nature must be understood before we can hope to be successful in it. But what an opportunity there is for those who will take it up thoroughly and intelligently!

The vegetable garden contains magnificent vegetables, many of which were first found by the wayside, or on the waste land by the sea, looking very small and insignificant.

The fruit garden is full of luscious fruits, which have all been derived from trees and bushes containing insignificant fruits, often with disagreeable tastes.

The flower garden.—It is here, perhaps, that to the ordinary observer the greatest strides have been made. When we think of some of the plants and flowers as they once were, and see what they are now, we marvel at the improvement, not only in colour and form, but in size. All this speaks of the careful work, perseverance, and forethought of others. But the work is not yet finished!

Every season there are produced vegetables of greater excellence, new varieties of flowers, and occasionally a new variety of fruit. Those who endeavour to raise the standard of our fruits must have the greatest amount of patience, as it takes many years before the young seedlings will fruit at all, and then many of them may be worthless, and others require further hybridizing to bring up some quality in which they are deficient. This may mean another wait
of ten or twelve years. But if success is attained, then a good work has been accomplished. This should be the aim of everyone, and especially every young gardener.

Before anyone can proceed with such work, he must understand what he is working with, and how he is to accomplish that work.

First we have the two essential parts of the flower, the androecium or stamens—the male part—and the gynaeceum or pistil—the female part.

Now, at the end of each of the stamens there is, in most cases, a small oval-shaped body, the anther. If we look closely at one of these anthers we find that, apparently, it is divided into two. This is really the case, there being two anther lobes, each with two pollen sacs in most anthers. But these are joined together by the connective tissue. Now, inside these sacs there is, at an early stage of their development, a longitudinal row of cells. These divide into four, forming the pollen grains. As they grow they absorb
some of the tissue inside the lobes, and when they are matured they are simply minute cells capable of an independent existence for some time. When the anthers are matured, the tissue at certain parts simply dries up and bursts, thus liberating the large number of little rounded cells—the pollen grains—which we see and can lift off with the point of a knife. Many of these pollen grains, when examined under the microscope, are found to be covered with little spines, while some actually have wings, enabling them to float about in the atmosphere.

The pistil consists of an ovary at the base, which is made up of one or more large cells. In each of these cells we have little bodies, some rounded, some flat. These are the ovules. On the top of the ovary there is sometimes a long, stalk-like process. This is the style.
the top of this is a more or less rounded knob called the stigma, which is slightly roughened on the surface. By the time the stigma is matured the ovules are fully formed and ready for fertilization.

In nature, pollination, and afterwards fertilization, take place by the agency of bees and other insects, and sometimes by the agency of wind. Self-pollination is sometimes effected.

We must get a clear idea of pollination and fertilization before we can go further. Pollination means simply the transferring of the pollen from the anthers to the stigma, whereas fertilization is the union of the nucleus of the pollen grain with the nucleus of the ovule. This takes place some time after pollination. In the case of Pines it takes place nine months after pollination has been effected. In other cases it only takes a few weeks, a few days, or even a few hours.

When the plants to be improved have been selected, the first thing is to see that there is no chance of pollination being effected except in the way desired. Therefore the anthers should be cut from the flowers which are required to produce the seed, thus preventing self-pollination. The flowers must be protected with small muslin bags, to prevent insects from effecting cross-fertilization. Then, when the stigma is matured, it may be safe to go over the flowers two or three days in succession with the pollen from the anthers of the flowers desired to be crossed, putting it on the ones selected as seed-bearers. If, however, the petals of the flowers being pollinated have dropped, it is a sign that fertilization has taken place.

It is a good plan to cross-pollinate the plants. That
is, have some seed-bearing flowers on each of the plants, taking the pollen from the one to pollinate the stigmas of the other, and vice versa.

There are rules we should always remember in the hybridization of plants.

1. Never cross two plants of weak constitution, however few the other varieties may be, as this will only intensify the weakness, and so make them easy victims to the attacks of disease.

2. Never cross two plants which have been badly diseased, as this will only hand down the weakened constitution to the young plants, and render them more liable to attacks of disease.

3. If a plant has a weak constitution, stronger qualities should be infused into it by crossing with a plant of stronger constitution, though perhaps not so good. If the young plants are not what is desired, cross again.

4. If a plant has good cooking qualities—e.g. the Potato—but is a poor cropper, then cross with one of good cropping quality.

5. If a plant whose flowers are of fine form and substance lacks colour, then cross with a plant whose blooms are of finer colour, though of coarser form and substance, and so on.

When should pollination take place? Of course when the pollen is in the proper condition, which is always the case when the anthers open or dehiscence takes place; and when the stigma is properly matured, which is not so easily judged, though, as a rule, when the flowers have newly opened fully the stigma is in the proper condition. This, however, is not an absolute rule, and the pollen
Hybridization and Crossbreeding

may be dusted on the stigma two or even three times on successive days, if needs be, to ensure it taking properly. It is no guide, either, to say that the stigma will be ready when the anthers are matured on flowers of the same age, the anthers, of course, having been cut out of the flowers you wish to pollinate, to prevent self-pollinization. Sometimes the anthers are matured before the stigma in the same flower—proterandrous. This is the case in plants belonging to the Umbelliferae, Composite, and Campanulaceae orders. In other cases the stigma is matured before the anthers—protogynous—as in Plantains, Arums, and Aristolochia.

When pollination has been effected, with both the pollen and stigma in the proper condition, the pollen grains germinate, and send out a little tube (the pollen tube). This grows right down through the tissue of the stigma and style until it reaches the ovary. It then makes its way to the small opening in the ovule—the micropyle—through which it enters into the embryo sac. It is then guided
by two large cells—the synergidæ—into the interior of the embryo sac. During the growth of the pollen tube there are three nuclei in it: one large vegetative nucleus, which is concerned with the growth of the tube itself, and two smaller nuclei, which are the generative nuclei. When the pollen tube has made its full growth, and reached the inside of the embryo sac, the apex is absorbed, the generative nuclei, with part of the protoplasm of the tube, pass out into the embryo sac, and one of them makes its way to the oosphere—a large naked cell within the embryo sac—and unites with its nucleus. This is fertilization. The oosphere then becomes the oospore. A cell wall is formed round it, and cell division goes on rapidly, ultimately forming the embryo, or rudimentary plant.

In dicotyledonous seeds—the bean, &c.—the whole of the food material is stored up in the embryo itself—in the fleshy seed leaves, or cotyledons. But in the monocotyledonous seeds—wheat, &c.—the food material—starch, &c.—is stored up in the cells outside the embryo.
Hybridization and Crossbreeding

When fertilization has taken place, the petals of the flowers, as a rule, drop off. They generally act as an attraction for insects to visit the flowers. These insects carry away some of the pollen and deposit it on the stigma of the next flower they visit, effecting pollination in a natural way. Therefore, after fertilization, the petals are of no further use to the plant, and are cast off.

As a result of fertilization, and the formation of the embryo and endosperm—the store cells for food materials—we get the seed.

Now we see at once how the qualities of the two parent plants are incorporated in the seed which results from cross-fertilization. The nucleus of the pollen grain, with its inherent qualities, unites with the nucleus of the embryo sac, thus combining, in the closest way possible, the qualities of both plants. When the seed is sown, however, we must not expect to get plants with all the good qualities of both parents, or even to get plants with the greater proportion of the good qualities of both. We often get something quite different from what we expect. We must go on again and again, and cross those plants with the best qualities, until we get what we desire, or as near
to it as possible. We must never be discouraged in this work, even if after three or four generations of crossing, when we have got well on our way towards the ideal, we find that a considerable portion of our seedlings revert to the characteristics of one of the former parents, and we apparently have to start all over again. However, this may not be so, as the next generation may take a long step in advance again.

Even when we have reached our ideal, we must not be content with that. We must fix our characteristics, at least if our plants are annuals or biennials, and require to be raised from seed. This is done by sowing year after year, taking away all plants which are not true in all detail to our perfected plant. The seed must be sown in places well away from any other plants of the same kind, to prevent any possibility of the flowers being cross-pollinated by insects from other and inferior flowers. Even when the characteristics are fixed, this precaution is necessary when growing plants for seed to keep the stock pure. Perennial plants, however, do not require such an amount of work and attention when once the ideal is reached, for these may be propagated in various ways, by cuttings, layers, budding, and grafting, &c., and will usually remain quite true. A branch, however, may sometimes revert to the old type, when it is termed “sporting”. These “sports” are sometimes quite distinct in their characteristics, and are propagated again as new varieties.

Hybridization is generally effected between plants of the same species: for example, one variety of Raspberry may quite successfully be crossed with another kind of Raspberry. It is often possible to cross two different
species of one genus, as has been done in the case of the Raspberry and the Blackberry, which gives us the Loganberry. It is even possible to carry it further, and cross two genera, but this is very rare indeed, and the genera must be nearly related to each other.

Sometimes, in highly bred flowers, the pollen becomes sterile. If this is suspected, the pollen should be examined under a microscope. If it is in any way shrivelled, it must be discarded; pollen in proper condition should be quite plump.

There is another difficulty for those who do not understand their plants thoroughly, that is, with regard to double flowers, and the method adopted in pollinating them.

Now we all know that double flowers are simply the flowers in which the stamens and pistil are changed into petals. Some of the petals, therefore, which are not perfectly formed, bear anthers on their margins, in which is produced pollen. It is from these anthers that the pollen should be taken to pollinate and fertilize the single or semi-double flowers, on purpose to ensure a large proportion of the seed producing double-flowering plants. As the pollen-bearing flowers cannot possibly be perfect in shape—for the petals are deformed to form anthers—it is increasingly necessary to select plants with perfectly shaped single or semi-double flowers to be the seed bearers. This will ensure not only that the flowers will be double, but that they will be of good form.

A thorough record of the work should be kept, so that steady progress may be made. Good results can only be looked for from thorough and systematic work with a high standard always in view.
One of the principal aims at the present time should be to endeavour to raise varieties of plants which will resist the attacks of disease. There are many plant diseases in existence, and from time to time fresh ones make their appearance. This is partly due to the artificial way of propagation which is continued indefinitely, and to the sacrificing of robust constitutions when hybridizing to other seemingly more important qualities, i.e. good cropping, good cooking, fine form, or fine colour. These should not be neglected by any means, but they are of little consequence in plants if they are not united with a thoroughly robust constitution.

CHAPTER XII
Weeds and Their Eradication

This is a subject of considerable importance to the gardener for many reasons. Have we ever asked ourselves what a weed is? At first this seems quite easy to answer, but on second thoughts we begin to wonder if it is as simple a question as we thought. If we have a root of Oats growing in our Onion bed, we say at once that it is a weed, and promptly take it out, although we do not class it as a weed if we see it growing in a field of Oats. Or, again, if a Potato is growing among the Carrots we take it out; yet if growing in its proper place, the Potato patch, we should be glad to see it grow to proper proportions. Hence we can say that a weed is a plant growing where it is not wanted. This definition
will not be far wrong, for Oats in an Onion bed or Potatoes among Carrots are just as much weeds as the common Groundsel or Chickweed would be.

Why, then, are we so anxious to get rid of the weeds from our garden?

1. Because, being much hardier than our cultivated plants, they grow much more quickly, and consequently choke the weaker plants.

2. If allowed to grow, they keep the light and air—two necessary requirements—from the cultivated plants.

3. They are plants themselves, and so compete with our crops for the food which is in the soil. Therefore we take all the measures possible to get rid of them, this method depending on the kind of weed desired to be disposed of, and the state of the weather.

4. If growing in paths and similar places, they spoil the beauty and harmony of the whole.

Weeds may be divided into two classes: annual and perennial. Annual weeds may be got rid of speedily, and without much trouble, by hoeing, that is, if the weather is fine and the work has been started early enough. When such weeds are small, and their roots turned up to the sun, by means of a Dutch hoe, they speedily die. In wet weather, however, this is not so easily accomplished, as the weeds will take root again. If the weather is only showery, the weeds, after being hoed, may be raked off; but if the ground is too wet, then hand weeding must be resorted to. This last is undoubtedly the best method of weeding, and frequently the most economical in the end. The weeds are lifted out by the root, taken away entirely, and either burned
or put in some place where there is no chance of their seed becoming ripened, and so getting back to the garden again.

The object aimed at with regard to annual weeds is to keep them from seeding. If this is done, at the end of the season the majority will be got rid of. Most soils are more or less infested with the seeds of certain weeds. These keep germinating, and, after the digging has been done, send up young shoots every season. When the ground is dug, seeds which have been buried deeply get nearer the influence of the sun and air and begin to grow. It is surprising how long the seeds of weeds will retain their vitality when buried deep in the soil. This is seen, sometimes, when soil which is turned up from a considerable depth gets covered very quickly with them.

Perennial weeds are more difficult to deal with. They generally root deeply in the soil, and if the tops are cut off with the hoe, they simply grow up again. Of course if this is done regularly, the plants will be weakened so much that they will eventually die, but this takes a long time. It will be found more satisfactory to dig the roots up and take them right away. Perennials are not, as a rule, so persistent as annual weeds, and when once the ground is thoroughly cleansed it is not difficult to keep it clear. Some of them, however, as Equisetum and Couch Grass, are very difficult to eradicate. Equisetum, especially, roots very deeply into the soil. It is found principally on damp soils.

At the end of the season, when trenching or rough digging is going on, the roots of perennial weeds should be carefully collected and taken away, while the annual
weeds, if they are not seeding, may be dug in, when they will act as green manure.

Weeds in rough walks may be got rid of by hoeing and raking; but in walks which are kept rolled, any big ones which may have been allowed to develop should be taken out with weeding knives. After this has been done, the walks should be watered with a good weed-killer once or twice in a season. This should keep them clean, and will save breaking up the surface in taking the weeds out. When using weed-killer, care must be taken not to let it come in contact with the grass or other edgings. It is also necessary to see that poultry are not allowed on these places until a considerable time has elapsed, as they may become poisoned by picking up the worms or insects that have been killed. The liquid form is the most convenient way of using weed-killer, and 1 part to 50 of water is the general strength. Directions for using are always given on the tins. "Eureka" is a very good and reliable weed-killer to use. It should be put on when the paths are damp. It will then get to the roots of the weeds and do its work. If put on when the paths are dry, considerably more of it must be used, as the paths will absorb a great deal, and some will be lost by evaporation.

Weeds on the lawn require to be dug out with a small fork, or they may be sprinkled with a preparation known as "Lawn Sand". This not only kills the weeds, but stimulates the growth of the grass. It is economical to use where the lawn is badly infested with Daisies and other weeds. Where there are many Plantains in the lawn an instrument may be used. This is filled with weed-killer. At one end is a small pointed tube. This
is pressed on to the crown of the weed, and sufficient poison is left behind to kill the latter. In a day or two they may be gathered up and taken away.

Groundsel, Shepherd’s Purse, and Chickweed are among the most common of the annuals, while Crowfoot, Bindweed, and Couch Grass are the chief of the perennial weeds.

CHAPTER XIII

Floral Decorations

This department of gardening is perhaps not so economically valuable as some of the others, yet it is one in which the individual taste can be shown to almost any extent. With so great a choice of lovely colours, and such a variety of forms, anyone with ordinary artistic taste can produce very good effects, while those possessing high artistic ideas can obtain effects of the greatest beauty. The great aim in decoration should be to get as near to the “real” as circumstances will allow. This should be borne in mind in all branches, whether domestic or personal.

TABLE DECORATION

Table decoration is the most important of all. This consists in first having a centre piece, which should be in proportion to the size of the table. When placing the flowers in this piece, care should be exercised not to crowd them too closely together, as this will not only spoil the natural effect, but prevent people from seeing
each other across the centre of the table. Smaller vases should be placed at intervals from the centre piece. The arrangement of these may correspond with the outline of the table. These should be filled with flowers correspondingly smaller than those in the centre. There should also be trails of Smilax, &c., round the centre and smaller vases, also running from the centre vase to each of the others. This should not be overdone, and should be in proportion to the size of the table. At each corner there should be a small vase filled with smaller flowers, and surrounded by trailers, which may again, if the table be a large one, be connected with the inner vases. Certain points, however, must be remembered.

1. Foliage and flowers must be selected so that the colours harmonize.

2. All parts of the table must be treated lightly, so that no diner is hidden.

3. The different sections must correspond with each other in colour, build, &c.

A word about the gathering of the flowers may be useful. If this is done in the early morning, they will keep fresher much longer than if gathered at any other time. The stalks should be placed in water, and kept in a cool, shady place until required.

Some of the plants with weak stems may require support to keep them in proper position. This is accomplished by wiring, and must be carefully done, or it will spoil the appearance of the whole. The wire, in the case of roses, may be stuck into the hip, and then stalk and wire bound with green bast. This should effectively hide the wire. In the case of orchids extreme care is
Garden Work

necessary. As the stems are tender, and the blooms as a rule very expensive, it is found advisable to wrap the stalks with cotton wool before wiring, to prevent the stems being injured; thus the flowers will remain fresh much longer.

Individual vases and flowers may be arranged in the same way as advised for table decoration, the colour of the flowers and foliage harmonizing with each other, and also with their surroundings. They should always be lightly arranged. Overcrowding should not be allowed on any account. The stalks should be of different lengths, and the whole arranged to imitate nature as far as the artificial conditions will allow.

Flowers with agreeable or sweet perfumes should always be selected for home decoration, those having a rank odour being avoided.
PERSONAL DECORATIONS

Bouquets of various kinds allow of great taste being displayed in the selection of flowers and foliage, and their arrangement. Flowers of outstanding merit should always be considered, but on no account should costly blooms be allowed to override the more important consideration of the harmony of colour and appropriate arrangement. The flowers should be the best of their kind procurable. They should be handled very carefully, so as to keep their freshness as long as possible. Nearly all the flowers for bouquets will have to be wired, not to give them a stiff appearance, but to keep them in position when they are arranged. In all cases the wiring will have to be done to suit the flowers. For the stronger ones, light wires may be used, the wire being pushed through the base of the flower, and doubled over. A turn or two of the long end of the wire may then be made round both its short end and the stalk. This will be found quite sufficient for some, and can be very quickly done. For more tender flowers the wire may be doubled over. The stalk should then be placed between the wires, and wrapped round with wrapping wire or green bast. Others, again, require even more careful handling. The stalks of these must first be protected with a small portion of cotton wool, then placed between doubled wire, and the whole bound up as before.

After all the flowers and foliage necessary have been carefully wired and laid out separately, the work of building the bouquet may be commenced. The foundation and artificial stalk will have been made with moss, thoroughly wired to keep it firm. After this it should be fixed in the
bouquet stand in a vertical position. Then the flowers which have been wired may be stuck firmly into the moss, those wires which come right through being turned into it again. During the building, great care will have to be taken to prevent any stiffness or formal arrangement and any crowding of the flowers. Each flower should be distinctly seen. Sprays of Gypsophila, &c., may be put in here and there to relieve the heaviness almost inevitable with the larger flowers. A few fronds of Asparagus plumosa, or Adiantum Fern, may be put here and there to tone down the colour and make the whole more effective. The building should be done straight forward, and no patching up should be done afterwards. All formality should be studiously avoided, but the finished bouquet should be quite symmetrical.

There are various kinds of bouquets which require special building. The ordinary hand bouquet is usually round in shape. The bride's bouquet is built more or less sideways, to allow of its being easily carried. Then there is the shower bouquet, which is altogether built sideways, with long trailers hanging from the ends of drooping flowers. The trailers may even have a few flowers at-
Floral Decorations

Sprays

Sprays can be very tastefully made. The flowers should be wired as above, after which they can be easily arranged. A large frond of *Asparagus plumosa*, or Adiantum (Maidenhair Fern), about the size of the spray that is wanted, should first be taken. Then start with the smaller flowers, about 2 in. from the apex of the fern. These should be laid on and wrapped round with wire, taking care to keep the wire between the small branches of the fern fronds, so that they will project on either side of the flowers. A small piece of Gypsophila may be put in here and there to relieve heaviness, and also a small piece of fern frond, to give a pleasing effect.

The stalks should be cut off about 2 in. below the flowers, and covered with tinsel paper, the wrapping wire being continued to this point. The tinsel paper will prevent the moisture from being dried up, and will also give a finished appearance to the spray. Sprays vary in size, according to individual tastes, but they lose beauty if too large.

Buttonhole Bouquets

These are comparatively easy to make, yet how often one sees clumsy arrangements which are called buttonholes! A buttonhole should always be small. A piece of Adiantum or *Asparagus plumosa*, with a rosebud, will make a perfect buttonhole. If anything more elaborate

tached to them. These latter must be very carefully fixed, so as not to show more than necessary. The trailers may be of *Asparagus plumosa*, or *Asparagus sprengeri*.
is desired, a small piece of Fern, &c., with one or two Tuberoses and a small piece of Bouvardia, may be used with pleasing effect. The flowers should be tied on to the fern as in the case of sprays, the wrapping wire being continued about 2 in. below these, and the stems wrapped round as before with tinsel paper.

**BASKETS OF FLOWERS**

These are a feature of many of our flower shows, cut flowers being arranged for effect. The size of the basket should be decided by the kind of flowers used. In no case should the basket be too large, or it will be unwieldy. For herbaceous flowers they may, of course, be fairly large, but for other flowers they should be of medium size. The basket may be filled with damp moss, and the stalks of the flowers stuck into this. The free and open style should be adopted, so that each flower may be seen separately. The colours of the flowers should harmonize with each other as well as with the foliage. Any formal arrangement should be avoided, but when finished the basket should be evenly balanced. The foliage should not be put in last, to hide defects, but as the building goes on, with a view to giving the whole a light and graceful appearance.

**WREATHS**

This form of floral work is different from any of the others, in that it is almost necessary to put the flowers close together to obtain the desired effect. White flowers are generally used in making wreaths, as they are looked upon as an emblem of purity, but lately almost any colours
are mixed with the white, sometimes with pleasing effect. Forget-me-nots, or a bunch of red roses at the base of a wreath of white stocks, &c., are very effective. Orchids of various colours are also frequently used. The foundations are generally made by tying moss on double-wire frames, the double wire preventing the moss from slipping. The flowers should be wired in the same way as for bouquets, only the wires should be shorter. After wiring, they should be stuck into the moss in any way desired. In some cases there may be a groundwork of smaller flowers, with larger ones put in here and there to relieve the monotony of closely packed blooms—or, again, a number of larger flowers, such as the Calla, or Richardia, may be placed at one point on the top, with one here and there in the circle, and Forget-me-nots or Roses at the base, while a quantity of Mahonia leaves may be wired, and a row placed both inside and outside at the base to form a groundwork.

There are many different forms of such floral work, but we generally mean a circle when we speak of a wreath. There are also the cross, the anchor, the shield, the heart, &c., but all are made more or less on the same principle.

CHAPTER XIV

Birds in the Garden

Birds in the garden are very troublesome, especially in certain seasons of the year. Some of them do a tremendous amount of harm in the springtime by destroying
the fruit buds on almost all kinds of fruit trees and bushes. They also do a great amount of injury to ripe fruit, both by eating and destroying it. But it must not be forgotten that many birds do a great deal of good by eating quantities of the larvæ of the injurious insects. Especially is this the case in the summer, when they are feeding their young. If birds can be prevented from doing damage to the fruit, they will be friends rather than enemies to the gardener. In small gardens this can be done by netting the fruit trees or bushes, but on the farms or in large orchards this is impossible. Some birds eat the buds only, and these should be destroyed or scared away.

The House Sparrow.—One of the most destructive of birds is the House Sparrow. It picks the buds more for mischief than for food. It will pick the tender centres from the Carnations, and will eat the Beet when it has appeared above the ground or even when it is 2 or 3 in. high. It will also destroy peas wholesale, and will scratch up and destroy many of our garden seeds. These birds must either be frightened away, or trees and bushes must be protected by netting, and the seeds by stretching black cotton along the rows immediately they have been sown. This will catch the feet of the birds when they are hopping about, and as they cannot see it they become frightened.

The House Sparrow also searches for, and destroys, the larvæ of the Ladybird, those useful little insects in a garden.

The Bullfinch.—This is another great enemy to the gardener. It does great damage in the springtime by destroying buds of fruit trees and bushes. If a sharp lookout is not kept at this season, the trees may soon be
Birds in the Garden

stripped of all their fruit buds. In districts where they are troublesome, the trees and bushes may require to be netted some time before the buds burst.

**The Blackbird and Thrush.**—These act very much in the same way, although their chief depredations are made on ripe fruit. In small gardens trees may be netted. In the spring these birds devour great numbers of slugs, and on the whole they do more harm than good.

**The Starling.**—The Starling may be considered a friend in any garden. In some places special boxes are built for it to nest in. It feeds on grubs and other enemies of the plants, and should be encouraged instead of driven away. It has been known to attack damsons and cherries, but its virtues in the garden greatly exceed its vices.

**The Cole-tit.**—This bird does much damage to Black Currant bushes in spring, stripping the leaves and eating the young bunches of embryo fruit inside.

**The Blue-tit.**—This is a useful bird to the gardener and the garden. It will wander about in the trees and bushes, picking up any little insect it comes across.

**The Chaffinch.**—The Chaffinch is another bird which does a considerable amount of damage in the early spring. It also devours the larvæ of the Ladybird.

**The Owl.**—This is among the most useful of birds in the garden. It catches and devours large numbers of mice, &c. If we had more of these birds about in some neighbourhoods we should hear less of damage being done to peas, &c., after sowing. The gamekeeper, however, is, in most cases, on the lookout for owls, as he rightly—or wrongly—imagines they do damage to his young game.
The Kestrel.—Another great friend to the gardener. It lives on mice, small birds, beetles, &c.

The Jay.—In some parts this bird does considerable damage to the fruit, not by eating it wholesale, but by taking a bite here, and another there, from any fruit it may fancy.

The Wood Pigeon.—These birds are great enemies to the gardener, and where they exist in large numbers must be watched and kept in check. They are fond of beans that have been newly sown or are just coming up, and will soon destroy whole rows. They also do considerable damage to plants by devouring the fresh green centres, especially in Cauliflowers, Cabbage, &c., or even, if hard pressed for food, by eating the whole plant. In the winter they will also attack and eat considerable quantities of winter greens which may be required for a totally different purpose.

The Sparrow Hawk.—A most useful bird, living as it does on mice and small birds. It unfortunately attacks young game birds, and therefore brings down the wrath of the gamekeeper on its head.

We thus see that the gardener has many friends as well as enemies among the birds. Those which feed on slugs, snails, &c., in the early season, but which feed on the fruit later, can be prevented from doing any damage to the fruit by netting the trees. Netting is comparatively cheap, and with ordinary care will last for a considerable time.
CHAPTER XV

Insects in the Garden

This is a most important subject in connection with gardening, and one which ought to be studied by gardeners far more than it is at the present time. There are very few plants which are free from attacks of insects of one kind or another. Some are attacked by only one kind of insect, while other plants are infested by several kinds, either in different seasons or at the same time. It is better, if possible, to prevent insects from getting a hold upon plants, because, in many instances, it is very difficult to get rid of them. This, however, must be done, if the highest value is to be obtained from the plants. Some say: "Why keep my plants clean when my neighbour neglects his and does not keep his clean?" This is a point with which the local authorities will have to deal in the near future, owing to the number of allotments and small holdings that are coming into existence. Those who neglect, ought, by law, to be compelled to keep their gardens and orchards free from insect pests, that is, as far as possible. Neglected gardens and orchards simply become a breeding ground for insects of all kinds. These, when the season comes round, take wing into fresh gardens, where there is not so much competition for food. Some of them which are surrounded by woolly matter may be carried about by the wind for considerable distances. These settle in a garden, and, if not detected at once, start what is called a "bad attack", for these pests multiply at a very rapid rate. Many insects have sucking mouths. They pierce a hole in the plant,
and by suction extract the substance from it. The damage is not apparent at first, but as time goes on, and the insects increase, the plant ceases to make any growth, gradually becoming stunted, and finally dies.

We also have the insects with the "biting mouths". These have strong jaws, and either eat their way over the surface of the plant or right through it. The depredations of these insects are immediately seen, either where they have eaten their way over or through the plant.

Before we proceed further, let us turn our attention for a short time to a typical insect, examine it, and go through its life-history. First we start with the egg. Segmentation takes place and goes on rapidly, and from the egg there is developed a living creature. This is, however, not a mature insect, it is only a larva, and will, in this stage, do the greatest amount of harm. The larvae are extremely difficult to satisfy with food, for they are feeding all the time during this stage of their development. They increase in size very quickly, and when the skin gets too tight to hold them they cast it off, another one in the meantime having been growing underneath. When this becomes too tight it is also thrown off, and so on, until the larva attains its full size. When this stage is reached the skin splits open again, but this time, instead of a larva of a different size, quite a distinct creature appears. This is a chrysalis or pupa. The pupa stage is generally passed in a period of rest. Before the larva casts its last skin a case is formed under that skin, and it is in this case that the pupal stage is passed. This covering is called the cocoon, and may often be found in the soil among leaves, &c. It is in this pupal stage that the changes are going on which
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convert the ugly caterpillar into the beautiful butterfly. When spring or summer comes, the perfect insect is matured inside the cocoon, which bursts, and into the world emerges the perfect insect. Perfect, that is, with the exception of its wings, which are not fully formed. In warm weather, however, the wings soon grow, and a few hours after hatching it will be ready for flight.

Thus we see that there are three distinct stages in the life of a typical insect. The egg gives rise to the larva, i.e. caterpillar, maggot, or grub; the larva produces the chrysalis, pupa, or nymph; and this in turn gives place to the imago or perfect insect. In plant lice, or aphides, however, there is very little difference between the larval and pupal stage. Some of the insects are harmful to plants, others may not only be harmless, but are indeed useful or even indispensable to the wellbeing of some of our plants. Bees, in collecting honey and pollen from the flowers, pollinate them, and so, when fertilization has taken place, we get our fruit and seeds. Then we have the Ladybirds. The larvæ of these live on aphides, and are therefore most useful in a garden. The larvæ of Ladybirds are small black or grey creatures, which may often be seen where there are many aphides or plant lice. The pupæ are
black and white, and are found on the under surface of leaves.

The Ichneumon Flies.—These are very great friends of the gardener, and should be protected. The female has a sharp ovipositor with which she pierces the body of the caterpillar, and then lays her eggs in the hole. In a short time the eggs hatch, and the little white grubs which are produced feed on the fatty tissue of the caterpillar, and by the time the grubs have grown to their full size the caterpillar is destroyed.

Thus we see how curiously these little flies assist the gardener in his work of keeping down injurious insects. The Ichneumon Flies have generally a long, thin body, with an ovipositor of varying length. The larvæ are small white grubs, but from their position of security are seldom seen. The pupæ may often be seen in numbers in small yellow cocoons hanging from the skin of the caterpillar they have destroyed.

The Glowworm, in the larval stage, feeds on snails,
even following them into their shells and eating them there. It has a kind of brush which is used to put aside the slimy matter given off by the animal.

Thus we see that not all insects are injurious to plant life. The majority, however, are decidedly so, and energetic methods should be taken to prevent attacks, or when attacks are made to destroy the insects before they are able to increase.

**Cabbage Butterfly.**—This is a most destructive insect to all plants of the Cabbage tribe. The large white butterfly or imago is known to everyone, as are also the green larvae which devour at a great rate the leaves of the plants. They will conceal themselves in the curd of Cauliflowers, from which place it is very difficult to dislodge them. When they have made their full growth they get away into some sheltered corner and change themselves into pupæ. These pale-green pupæ, spotted with black, may be seen attached by the tail, and by a cord round the body, to the wall, fence, or other place where they have found shelter. To check these pests the young plants may be drenched with soapy water or dusted over with lime and soot. If in small numbers, the plants may be gone over and the caterpillars picked off and destroyed.

**Onion Fly.**—This is another most troublesome insect.
The little fly, which is dark grey in colour and covered with short hairs, may be seen every season of the year. It generally makes its first attack on the Onion crop about "thinning time", but at no time will the crop be safe, as this pest will attack full-grown onions as readily as it does young ones. The eggs are generally laid in the onion, just at the level of the surface of the soil, and in a few days the little white maggots are hatched. These eat their way down to the base of the bulb, and then round it, after which the bulbs begin to decay. The first sign of attack is when the plants become sickly looking; afterwards they collapse altogether. When the larvae or maggots are fully grown they change into pupae in the soil.

As soon as the plants show signs of the presence of maggots they should be carefully dug up and burned. If the Onion bed is kept dusted over slightly with soot in the early part of the season, or if sprinkled with paraffin and water, in the proportion of 1 oz. of paraffin to 1 gall. of water, using a fine rose on the watering can, this will make the plants distasteful to the insects, and also kill the smell of the onions, which might otherwise attract them. If the plants are rendered distasteful to the insects the females will not settle on them to lay
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their eggs. When once the insects are established, no remedy is possible, as they get under the scales of the bulbs, and these act as an umbrella, and so protect them from anything that may be put on the garden. The ground, after an attack, may be treated with gas lime. This will kill the maggots or pupae. As a precaution, Onions should not be sown on the same ground for a year or two.

**Carrot Fly.**—This is another very destructive creature. It is a small greenish-black insect and may be seen about the Carrot bed at almost any time of the season. It lays its eggs in or near the Carrot, and in a short time a little yellowish maggot is hatched. This little maggot gradually eats its way into and down the Carrot until it comes to the tip of the root, through which it eats its way. By this time the tops of the Carrots have turned a yellowish green, and soon collapse. When the larvae have completed their growth they leave the Carrot and turn into pupae in the soil. During the summer this state of things only lasts for about three weeks, when a fresh batch of flies makes its appearance. In winter, however, the pupal stage lasts for a considerable time.

The thinning of Carrots should be done carefully, in
dull, damp weather, when there is no chance of the flies being on the wing, for these flies seem to be attracted by the smell of Carrots when they are disturbed. For this reason, weeding, &c., should be done, if possible, in dull weather, especially in infested districts. After thinning has been done, the soil should be drawn up round the base of the leaves, and the bed should be sprinkled with paraffin and water, or soot, as advised for the Onion. This should be repeated at intervals during the season. After an attack the ground should be treated with gas lime, and, if possible, Carrots should not be grown on the same ground for a year or two.

**Celery Fly.**—In some districts, and in some seasons, this fly is a very troublesome pest to the Celery crop. It is pale brown in colour and hovers about the Celery, generally during the month of June. After the eggs are laid, the maggots appear in a very short time. These eat their way through the tissue of the leaves, forming the large familiar blisters. When the larva has grown to its full size it either changes into a pupa in the leaf itself or it may drop off and pupate in the soil. From the pupa emerges the mature fly. Three or four broods may be matured in one season. From the rapidity with which they increase it will be evident that energetic
measures will have to be taken to keep these insects down. In infested districts the plants should be dusted with soot or lime, or sprinkled with paraffin and water, as for the Onion Fly, or the plant may be regularly sprinkled over with weak manure water, all of which make the leaves of the plants distasteful to the insects. If by chance some eggs have been laid, and blisters appear, the leaves should be opened at once and the maggot killed or the pieces of leaves with the blisters may be taken off and burned.

**Plant Lice or Aphides.**—These are the best-known insects in the garden. Almost all plants are at times attacked by them. There are said to be about three hundred species, each having its own particular kind of plant to feed upon. They not only attack plants in the open, but also in the greenhouse. The Greenfly of our Roses, and the Blackfly of our Beans, are known only too well to all who have anything to do with a garden.

Aphides have many curious characteristics. One of the most peculiar is the production of living young. These young will produce others, and so on. Thus we can account for the very rapid multiplication of these insects. Another characteristic is that there is very little difference between the appearance of the larva, the pupa, and the imago or perfect insect. These insects are furnished with a sucking mouth or proboscis. This is sharp, and pierces the plant, generally in the tender parts, i.e. the apex of the Bean plant, or of the Rose shoot, &c., from which they suck the sap. If they appear in large numbers, they may damage the plants so badly that they will die. These insects, like almost all others, breathe through pores which are situated in various parts of their body, known
as stigmata, or spiracles, and are simply the openings into the breathing tubes or tracheae. Now, if these tubes are choked or blocked, the insects must die. The writer remembers a fine border containing hundreds of Roses which were very badly infested with "the fly". The owner was about to prepare some material with which to destroy them, when a strong wind sprang up, blowing the dust in clouds all over the bushes, leaving them quite white. During the night a heavy storm came on, and in the morning the bushes were found to be entirely free from "the fly". The dust had clogged their breathing tubes, causing the creatures to be suffocated, and the rain had washed the dead insects off.

A good remedy is to mix 2 oz. of soft soap in a little water. Into this put 1 oz. of paraffin oil, then make up to 1 gall. with boiling water, stirring thoroughly while pouring the latter in. After it has cooled it should be well stirred and put on the plants with a syringe, to ensure it being forced in among the insects. The soft soap makes the material stick to the insects. This should be done in the evening, when the sun goes down. Quassia chips are another safe remedy for Greenfly. It is, however, a tedious mixture to prepare. One pound of the chips should be steeped in water for a considerable time, then put into a vessel with 1 gall. of water, and allowed to simmer for from twelve to twenty-four hours, after which it should be thoroughly mixed with 10 oz. of soft soap and then made up to 10 gall. with water. This is a safe and effective remedy for Greenfly, &c.

American Blight or Woolly Aphis.—This insect belongs to the same class as the ordinary Aphis, but it
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is covered with a woolly material which serves as a protection and makes it more difficult to eradicate when it gets a hold. It generally attacks the Apple tree, lodging in wounds or clefts in the branches, &c., after causing wart-like outgrowths on the stem. If the trees are badly attacked, they may be syringed with the quassia soft-soap wash or the soft-soap paraffin wash, putting it on after rain. It should be syringed on with as much force as possible, so that the liquid will go right in among the insects. If a garden engine can be used, so much the better. If the trees are not badly infested, they may be gone over with a small brush dipped in pure paraffin or methylated spirit.

Click Beetle or Wireworm.—No insect does such extensive damage as the Wireworm. It is hatched from the eggs of the Click Beetle or Skipjack. The beetle gets its name from the peculiar way it has of righting itself when it gets turned on its back. In doing this, instead of making use of its legs, which are very small, it presses its head against the ground and arches its body, a small part of which fits into a notch. This is forced
out, and in springing back into position quickly, sends the beetle up into the air. If not righted the first time, this action is repeated until it is successful. The female lays her eggs in the soil near the roots of plants, and in a short time the larvae are hatched. These are known as Wireworms from their wire-like appearance and hardness.

The larvae of Wireworms live for three, four, or even five years in the ground. Thus they are found in different stages of development at any season of the year. During severe frosts they work their way deeper into the soil, but when the spring or summer comes they rise near the surface, where they feed on the roots of many plants. The great amount of damage which they are able to do is best seen in a field of wheat, where they cause enormous havoc. In the garden they are most destructive. A good way to trap many of these harmful creatures is to place slices of potatoes a little way below the surface of the ground, inserting sticks to mark the places where the slices are placed. These should be taken up in the morning and the Wireworms destroyed. As many as twenty-four Wireworms have been caught in a single spot in one night by this method. Birds are fond

1 and 2, Variety of Click-beetle (nat. size and magnified). 3 and 4, Another variety (nat. size and magnified). 5 and 6, Third variety (nat. size and magnified). 7, Larva of 5. 8 and 9, Larva of 2 (nat. size and magnified). 10 and 11, Pupa of wireworm (nat. size and magnified).
of Wireworms. Robins will follow the digger and feed on the worms as they are turned up by the spade. Starlings are also very fond of them. The ground may be turned up two or three times during the season to facilitate the work of the birds in searching for them. It is stated that these insects do not like seaweed, and land manured with seaweed is more or less free from this pest. Gas lime put on at the rate of about 30 lb. per pole is also effective in thinning them out. Sometimes a crop may be saved by giving a dressing of nitrate of soda at the rate of about 1 lb. to the pole. This stimulates the plants and causes them to grow rapidly at the time when they would fall an easy prey to the attacks of this pest.

**Craneflies or Daddy-long-legs.** — Everyone is familiar with the Daddy-long-legs, which is, of course, the perfect insect. The female lays her eggs at the base of plants. These soon hatch out into the larvae or maggots, known by the name of "Leather Jackets". They are brownish in colour—almost like a piece of decayed wood—and have a very tough skin, from which they take their name. They do a great deal of damage to vegetables, especially to young plants of the Lettuce and Cabbage species. They also cause havoc on the farm by destroying the roots of grass and corn. They
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turn into pupæ from July onwards, and during August and September the perfect insect appears. They like a damp situation. If the ground is well drained, therefore, it has the effect of reducing these pests. Gas lime at the rate of 40 to 50 lb. per pole will kill the eggs or larvæ. Starlings and Rooks are very fond of the larvæ of these insects and devour great quantities.

**Cockchafer.**—This is another destructive insect. It is brown in colour, and has down on the breast. The beetle lays her eggs in the ground, and after a time the maggots are hatched. The larvæ often live in the ground for three years, doing considerable damage to the roots of plants. When fully grown they may be 2 in. long, but are generally found in a bent position, being white and swollen at the end. They feed on the roots of all kinds of plants. As winter approaches they make their way deeper into the soil. During September they change into brown pupæ. This stage usually lasts for two months, when the imago appears and hibernates for a time. In the following spring the perfect insect again appears and feeds on the leaves of various trees, doing considerable harm. A method sometimes employed to trap these insects is to lay down sods with the grassy side downwards. The larvæ gather under these and may thus easily be destroyed.

**Earwig.**—This is another troublesome insect. The female lays her eggs in little packets, and is said to brood over them as a hen does. The young larva is like the perfect insect. They are vegetable feeders and are very troublesome on Dahlias and Chrysanthemums, eating the flower buds and the young leaves. They may be trapped
in large numbers, in the case of Dahlias, by placing small flower pots containing a little moss on the top of stakes, the flower pots being inverted. The Earwigs, after feeding on the buds, make their way up the stake and hide among the moss. The pots should be looked over regularly and the insects destroyed. For Chrysanthemums the same means may be adopted, or small pieces of the hollow stems of beans may be laid about on the pots. The insects will hide in these and can thus easily be destroyed. The tops of Chrysanthemum plants should be carefully looked over, for the Earwigs will often try to hide among the crowded leaves at the top. Earwigs keep in hiding during the day and come out to feed at night.

**Codlin Moth.**—This is one of the worst insects in the garden, causing a great amount of injury to the Apple crop. The moth is about \( \frac{3}{4} \) in. across the wings from tip to tip. It is of a light-grey colour, with copper-coloured markings. The perfect insects appear in early summer. The females lay their eggs in the young fruit, generally one in the eye of each apple. In a short time these are hatched, and a small white maggot is produced, which commences to eat its way into the apple, going right through to the other side, making a hole in the skin, but afterwards returning to the core of the apple. The maggot feeds for some time on the pips. Thus it is that the apples drop prematurely. If one of these apples is picked up, and cut through, the maggot is often found inside, and its passage through the apple is easily traced. Soon after the apple falls, the maggot makes its way out of it and crawls to the trunk of the tree. There it
finds shelter behind some of the rough bark, spins a cocoon, and, if not disturbed, passes the winter there. In the early summer the perfect insect appears. This will again carry on the same work.

One means of checking these insects will be apparent to all, viz. to go round the trees and gather up all apples that are newly fallen and destroy the insects. Another preventive measure is to keep the trunks of the trees clean, so that there will be no harbour for the pupae during winter. A piece of any old material may be tied round the trunk. The pupae will collect in this, when the wrapping may be removed and the insects destroyed. The trees may be sprayed over with Paris green at the rate of 1 oz. to 12 gall. of water, or London purple in the proportion of 1 oz. to 16 gall. The first spraying should be done just after the petals have fallen, when fertilization will have taken place; the second about fourteen
days later; and the third fourteen days after that. As these are poisonous washes, they should never be used on fruit trees or bushes when the fruit is of any size. It is advisable to add twice as much lime as Paris green or London purple, in case there is any soluble arsenic in them which might do injury to the foliage of the trees.

Winter Moth.—This is another most destructive insect in the orchard. The female crawls up the stems of fruit trees during the winter season, commencing to lay her eggs in the clefts of branches, &c., in October or November. This goes on all through the winter. In the spring time these eggs are hatched and the larvae make their appearance. When full grown these are about 1 in. in length. They are of various colours: grey, green, or even black. They feed rapidly on the foliage of many of the fruit trees, or even on the buds of flowers. When full grown, the larvae lower themselves to the ground by means of a thread, and turn into pupæ in the soil. Sometimes a few pupate under the rough bark of the trees. It is during May and June that these larvae are changed into the pupæ, the perfect insects appearing the following winter to carry on the work. If a late brood is produced, they may even attack the young fruit.

Now for such destructive insects every means possible must be taken to keep them in check or to destroy them entirely. A good method is to place grease bands on the trees, but care must be taken to get grease-proof paper; otherwise considerable injury may be done to the trees themselves. The paper should be tied above and below with bast, then a grease of some kind, which will remain soft for a long period, should be smeared over
it. Cart grease, bird lime, or vaseline may be used. If the grease should get dry it must be renewed. The female insects, which are wingless, crawl up the stems, get caught by the grease, and are thus unable to lay their eggs. Though this may check the egg-laying to some extent, it does not entirely stop it, as the wingless females have been known to be carried above these grease bands by the males. The eggs are usually laid at the ends of the shoots. This makes it easy to destroy large numbers of them by late pruning. In badly infested districts larvæ are sometimes to be found on trees even when all these precautions are taken. The only way to get rid of these is to spray the trees with some poisonous wash, such as Paris green or London purple, in the proportions given for the Codlin Moth.

**Slugworms.**—These are the larvæ of certain Saw-flies. They do considerable damage to many trees, such as the Apple, Pear, Cherry, Plum, &c. The Sawfly is about \( \frac{1}{4} \) in. long, is black in colour and hairy. The female lays her eggs on the under surface of the leaves, and in a short time the larvæ are hatched. These are at first white, but ultimately become green, or nearly black. They are covered with a sticky substance. They do a great amount of damage to the leaves of the trees, which
they attack by eating the epidermis. The whole leaf then dies and falls off. When the larvae are full grown they drop to the ground, make their way into it for a short distance, and spin black cocoons in which to pass the pupa state. They are difficult to eradicate, as they appear on the trees at a time when it is more or less dangerous to spray with poisonous substances.

**Red Spider.**—This, by the way, is not a spider at all, but a mite, and is known to all who grow vines. It has probably got its name from the habit it has of spinning a slender web, under which it shelters. It feeds by sucking the nourishment from the tissues of the leaves. It infests many other plants and trees besides the Vine, such as the Peach, Cherry, Strawberry, Violet, &c. It generally makes its appearance if the trees receive a check of any kind from draughts, or by getting dry at the roots. These things should therefore be carefully avoided. If the slightest trace of this pest is seen, syringing should be resorted to at once and continued regularly so long as it is safe to do so without injury to the fruit, using pure water only. This must be put on with considerable force, especially on the under parts of the leaves. The liquid will then penetrate the web and check the increase of the spider, while it will always keep the foliage fresh and healthy. Trees in the open are liable to attack, especially in a dry season. These should be kept well watered and even mulched. Occasional syringing will also be beneficial, this being done in the early morning and late afternoon. If the trees become badly infested, some other remedy will have to employed, such as dusting the leaves with flowers of sulphur, or a solution may be
made, if preferred, by boiling 1 lb. of sulphur with 2 lb. of quicklime in 4 gall. of water. Small plants may be dipped in this or syringed on the under sides of the leaves. Gishurst compound and quassia chips, prepared as before advised, may also be used. Strict care, however, in ventilation, watering, &c., will prevent this pest from making its appearance. The harm which this insect does is not so very noticeable the same season, unless the attack is exceptionally early and severe, but, the leaves being more or less destroyed later in the season, the fruit buds will not be properly nourished and the crop will suffer the following year.

**Thrips.**—This is another class of insect troublesome to the gardener. The eggs are laid on the leaves of certain plants, and in a short time the larvæ are hatched out. These immediately set about destruction. By means of their proboscis the insects suck the nourishment from the cells of the leaves, which turn whitish in colour and then shrivel. The insects are easily distinguished on the leaves, being long in shape and black or very dark in colour. They do more damage to the tender foliage of stove and greenhouse plants than to the more hardy and tougher leaves, &c., of the outside ones. Peas sometimes suffer considerably from these insects, especially the young foliage. When they make their appearance on these plants the latter should be syringed with soapy water, 2 oz. of soft soap to 1 gall. of water. The quassia wash may also be used. If the attack is not very severe, numbers of the insects may be killed by drawing the finger and thumb up the leaves, crushing the insects, but not pressing hard enough to injure the
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plants. In the greenhouse the plants may be dipped in soapy water or in the quassia wash, &c.

**Wasps.**—These well-known creatures do some little good by devouring large numbers of insects, but, on the other hand, they are generally disliked, not only on account of their sting, but for the damage they do to the fruit. This may be so extensive as to ruin the whole crop.

Everyone is familiar with the nests of these insects, which may be found either in banks, in holes in the ground, or hanging from the branches of trees and bushes. It is better to prevent these nests from being made than to destroy them afterwards. This can be done by watching for, and destroying, all the queen Wasps that can be found. The Wasps that we see in the springtime flying about and exploring all the little holes in banks, &c., are queens. They are in search of suitable quarters in which to start building their nests. So we see that every queen destroyed at this time is one nest the less to be formed. When a queen has found a suitable place it immediately makes a few cells, in each of which an egg is laid. After a short period these eggs are hatched into little larvæ. These are fed for some time on honey, which is either collected from flowers or obtained by robbing bees. When the larvæ are full grown the ends of the cells are covered over and the larvæ become pupæ, from which stage they appear shortly as perfect insects. In the meantime the queen has been forming more cells and laying an egg in each. As soon as the first batch of young Wasps is matured they collect food for the other larvæ, &c. So the work goes on, the Wasps multiplying
very rapidly. In dry seasons, by the time the fruit is ripe, they become a source of great trouble. In some districts fruit-growers pay boys for all the queen Wasps that they kill during the spring. In this way great numbers are destroyed, and of course in each case a nest prevented. This means the prevention of countless numbers of Wasps being hatched and the lessening of damage that otherwise would be done.

If the nests have been formed they must be looked for and destroyed. During the day, search should be made, and wherever one is found a stick should be set up, but no attempt made to destroy it then, as many of the Wasps will be out on the wing. The evening, when all the Wasps are at home, is the time to destroy them. The hanging nests are easily destroyed by using a large torch on a stick and holding it to the hole at the bottom of the nest, thus burning it and any Wasps that may try to escape. This way, however, may entail considerable damage to the tree or bush. If this is to be avoided, the hole at the bottom should be carefully plugged up and the branch cut out, having a large torch ready to lay the nest on. A bee veil should be worn as a precaution in this work. For nests in the ground, various methods are adopted. If the holes are straight, or sloping in a downward direction, tar may be poured in, thus effectually destroying them; but for those which go straight into a bank, or incline upwards, it is better to use cyanide of potassium, the fumes of which kill the Wasps immediately. Care has to be taken with this, as the fumes given off are extremely poisonous. Great precaution, however, should always be exercised in dealing with
Wasps, as their stings are not only very painful, but sometimes dangerous.

The following are some of the chief insect enemies of the gardener:

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**Insects Injurious to Cabbages**

- Cabbage Caterpillar
- Cabbage Fly
- Cabbage Gall Weevil
- Wireworm
- Leather Jacket

**Insects Injurious to Turnips**

- Turnip Fly
- Turnip Moth
- Turnip Sawfly
- Turnip Seed Weevil

**Insects Injurious to Carrots**

- Carrot Fly

**Insects Injurious to Onions**

- Onion Fly

**Insects Injurious to Peas**

- Pea Weevil
- Wireworm
- Greenfly
- Thrips
- Pea Moth

**Insects Injurious to Beans**

- Blackfly
- Bean Beetle

**Insects Injurious to Celery**

- Celery Fly

**Insects Injurious to Apples**

- Codlin Moth
- Apple Blossom Weevil
- Apple Mussel Scale

**Insects Injurious to Pears**

- Goat Moth
- Pear Oyster Scale
- Winter Moth
- Slug Worm
- Aphis
- Winter Moth
Insects Injurious to Plums—
Lackey Moth. Slug Worm.
Winter Moth. Aphis.

Insects Injurious to Cherries—
Blackfly.

As space will not permit of a full description of insects, injurious or otherwise, in a work of this kind, the reader is referred to books specially written on the subject, as: *Insect Life*, by Fred. V. Theobald, M.A.; *Farm and Garden Insects*, by Wm. Somerville, M.A., D.Sc.

CHAPTER XVI

Plant Diseases

This is a subject of extreme importance to gardeners, fruit-growers, foresters, farmers, and all those who have the care of plants of any kind. The Government has been a long time in recognizing the need of special facilities to carry out research work in connection with this important branch, but it is pleasant to hear that the State has at last lent its aid. It is earnestly hoped that much will now be done to prevent the enormous waste to the crops which goes on year after year from the attacks of diseases of various kinds. The Government states that there are not men sufficiently qualified to carry on this research work. This is indeed true, and it is not to be wondered at, considering the training such work requires, training that is severe, because only
those can hope to cure diseases in plants who understand the plants thoroughly.

The first step in such training is to obtain a complete knowledge of those plants which are to be cured of disease, or, better still, kept free from it. The diseases themselves must then be thoroughly understood, how they act, and what will destroy them without injuring the plants. Of course this, to be of any use, must be done economically.

Now the reader already knows something of the plant itself. We may therefore go on to study the diseases. There are a great many of these. They are of various kinds, and act in different ways. Not only this, but some, at different stages of their development, appear to be quite different, act in a different kind of way, and produce different results. Thus it will be seen that the study of plant diseases is a difficult matter. When practical operations commence it is found to be more difficult still, for during one stage of a disease it will not injure a particular plant, while at another stage it will do considerable damage. Even if we root out and destroy all diseased plants, fresh ones may be infected by a disease of an entirely different kind, and by what appears to be a distinctly different species; but later it is found to be only another stage of the same disease. Not all diseases, however, have such complicated life-histories. Many are straightforward from beginning to end.
THE POTATO DISEASE

The spore—as the little seeds of the lower plants are called—on germinating produces a little tube, which grows on the surface of the leaf until it comes to a stoma or air pore. Through this it enters into the tissue of the leaf. When once inside, its work of destruction begins. It devours the substance of the cell into which it enters, after which it grows out against the inner wall, and is able to absorb this. It then enters the adjoining cell, eating its contents, and so on, until it robs all the surrounding cells, leaving them quite dead. The black spots which we see on the Potato plants at certain times of the year are really patches of cells that have been killed by this disease. But this is not all. If these black patches are closely examined, slender, whitish-looking hairs may be observed
sticking out of them. If these hair-like structures are examined under a microscope, they will be found to consist of little stalks bearing branches, which in turn bear very minute oval bodies or spores. These spores do not give rise directly to the disease plant. They divide into a number of smaller spores, which are able to swim about in the smallest particle of moisture by means of two cilia. The slightest quantity of dew is sufficient for these zoospores, as they are called. In this moisture they germinate, and so give rise to the disease plant. The little thread-like structures already spoken of are the fruiting branches or conidiophores of the disease plant. The plant itself is inside the Potato leaf, and is made up of a mass of hyphæ or little tubes, which is called the mycelium. When the mycelium has made considerable growth, it begins to send out fruiting branches. These make their way to the stomata on the leaves, and grow out through them into the atmosphere, and there form the spores. While the fruiting branches or conidiophores are being
sent out at one point, the mycelium or disease plant is still growing inside the tissue of the leaves, and even into the stem, and ultimately down into the tubers themselves. The little hyphae make their way from cell to cell by absorbing cell walls in their course, and devouring the cell contents, until they reach the tubers, where they carry on their work of destruction, leaving the brown patches on the tubers. Some of the little zoospores may be washed from the leaves to the soil or to any exposed young tubers. On these they germinate, and so infect the tubers in a direct manner. When the colder weather comes, this mycelium is arrested in its growth, but it is able to exist in this state during the winter. If these infected tubers are planted the following season, as soon as the warm weather sets in the mycelium begins to grow, and, making its way up the stem into the leaves, produces fruiting branches and spores, which are again able to spread the disease.

Now, the above ought to have taught several lessons with regard to this disease. First, no infected potatoes should be planted; that is, potatoes with brownish spots on them. If any appear doubtful, it is far better to leave these out also. Second, care must be taken not to allow the disease to get a start, if possible, because when once the disease gets established inside the tissue of the plant it is impossible to get at it to destroy it. We may kill all the parts on the outside of the plant by spraying, but if the mycelium has got inside it will go on growing, and burst out in other places later on. Third, on no account must any diseased tubers be left on, or in, the ground, as the disease will lie dormant during the winter, but will spring
into growth later on and infect any healthy tubers in its neighbourhood. The diseased tubers must not be given to pigs or cattle, for some may be left among the farm manure, and be taken out into the garden or field, there to set up the disease again. They should, however, be carefully taken away, the worst ones burned, or mixed with quicklime, and the others boiled. These latter may then be given to the animals. There will then be no fear of the disease finding its way back from this source. The whole of the tubers should be carefully looked over, especially those which are put into a clamp and kept for a considerable time, because if the weather is mild the disease in the tubers may start into growth, and, having no outlet in stem or leaf, the whole tuber will be destroyed. The disease will then make its way into others and destroy them also; then when the clamp is opened a great portion of the tubers will be found to be destroyed. This would probably not have happened had the potatoes been carefully examined before storing.

The method adopted by most growers of storing their potatoes in boxes placed in cool sheds, effectually prevents any chance of the temperature rising, and so starting the mycelium into growth during this period. Even then care should be taken not to include any diseased tubers, as the disease will lie quite dormant while they are in the boxes, but as soon as they are planted the stems and leaves will become infected, spores will be produced, and the whole crop may suffer.

Some seasons are more favourable than others to the spread of this disease. In damp seasons it spreads most rapidly. This is not to be wondered at when we know
the nature of the disease. The spores are so very minute that they float about in the atmosphere, the slightest wind carrying them far from where they are produced, and wherever they alight on a Potato leaf, on which is the slightest moisture, they will germinate, and so spread the disease. The disease is most prevalent in damp situations. In light, dry seasons one is not so much troubled with it, as sunshine itself is a check, and, the leaves being dry, the spores which may be formed do not have a chance of dividing into the small zoospores, and these again have no opportunity of germinating. In the present state of horticulture and agriculture, however, whilst no law exists compelling people to take care of their crops, and keep them free from disease, precautions must be taken to prevent the swarms of spores flying from a neighbour's garden or field from alighting on the leaves of our Potatoes, and causing the disease. This is done by spraying with Bordeaux mixture. This is the best preventive known at present. Not only does it arrest the spread of the disease, but it stimulates the growth of the plants, and increases their yield.

It is made up of—

12 lb. copper sulphate (bluestone).
8 " quicklime.
100 gall. water.

Or—

10 oz. copper sulphate.
6 " quicklime.
5 gall. water.

The copper sulphate should be dissolved by putting it into a small quantity of boiling water. This should then
be added to the rest of the water. The lime, which should be of the finest quality, should be stirred up into a milky liquid. It should then be poured into the liquid containing the copper sulphate, which, by the way, should always be put into a wooden vessel. The mixture should be thoroughly stirred, and is then ready for use. This will keep for a week, but it is better to make it as required. Bordeaux mixture should be put on with a sprayer, as it is then possible to get at the under surface as well as the top of the leaves. As this is a preventive, and not a cure, it must be put on when it will act as such, that is, before the disease has a chance of getting a hold upon the Potatoes. About the middle of June is generally considered to be a safe time for the first spraying, the disease seldom making its appearance before that date. A second spraying may be given about the middle of July, and a third about the middle of August. This, if the spraying has been thoroughly done, should keep the crop free from disease.

**BLACK SCAB**

This disease is even more terrible than the last. It causes large warty growths on the tubers, and sometimes even on the stems, when there is a bad attack of it. Very little is yet known about its life-history, but when a crop of Potatoes is attacked by it, the disease will remain in the ground for five or six years. The warts are full of tiny little spores or seeds, and when they burst, the spores are liberated in countless numbers into the soil. These attack the potatoes that in future years may be planted in this soil. The terrible thing about these spores is the long
time they are able to keep alive in the ground. Even if potatoes are not grown in this soil for five years, yet in the sixth year they are almost sure to contract the disease, and propagate it for another period of time.

Now, for such a disease as this, and upon such an important crop as the Potato, most stringent methods for its eradication must be employed. The Government has been alive to the necessity of keeping it in check, and so, to prevent it spreading, has made it a notifiable disease. Anyone—whether growing for sale or private use—who fails to notify this disease is liable to a fine not exceeding £10. Wherever this disease makes its appearance, the plants affected should be carefully dug up, and the whole plant, haulms and tubers, burned. The ground also, where the infected crop was grown, should be dressed with about 60 lb. of gas lime per pole, or 4 tons to the acre. This will destroy many of the spores, but as an extra precaution no Potatoes should be grown on the infected ground for at least six years.

DAMPING-OFF DISEASE

This is the disease that causes such havoc among the seedlings in the springtime, almost all gardeners being familiar with it. The spores appear to be present in most soils, and only require suitable conditions for them to germinate and infect the seedlings. When germination takes place a small tube or hypha is sent out. This makes its way to the seedling that is near, and penetrates the epidermis into the tissues of the plant; there it devours the nourishment from the cell. After this it makes its way
into the next cell by absorbing the cell wall. In this way it works right through the tissue of the small seedling. A network of hyphalae is formed by this time. This is known as the mycelium or disease plant. When the disease has made its way through, the seedling drops over, and soon dies. In the meantime the mycelium continues to grow, and comes again to the outside of the plant tissue to form fruiting branches. At the apex of each of these branches a little spore is formed, called a conidium. These conidia, on germinating, produce a little hypha which, entering another seedling, again gives rise to the disease. They may, however, on germination, produce only a small tube with a sac at the apex of it, the contents of which divide into a number of small spores, each with two cilia attached. These are able to swim about in any moisture which may be present, and for this reason are called zoospores. These

zoospores in a short time germinate, thus giving rise to a hypha, which penetrates a small seedling, producing the disease.

There is also a sexual stage in this disease. An oogonium, or female organ, and an antheridium, or male organ, are produced. The antheridium comes in contact with the oogonium. The walls at the point of contact are absorbed, and the contents of the antheridium pass into the oogonium, thus effecting fertilization. The result of this is that an oospore is formed. This may either germinate at once, giving rise to a small hypha, or it may form a little sac, the contents of which divide into zoospores; or, again, it may cover itself with a thick coat, and remain dormant in the soil for a considerable time, afterwards giving rise to the zoospores or mycelium. The zoospore stage is only produced when there is sufficient moisture in which they can swim. Both conidia and oosporates may remain dormant in the soil if conditions are not favourable for their germination. Dryness is the great drawback to the development of this disease. Therefore if the seed beds are kept on the dry side, there is no fear of it making its appearance. Another condition which is essential is thin sowing. If the seedlings are crowded, and if by any chance they get overwatered, Pythium is almost sure to make its appearance, and, having plenty of plants to feed upon, it is almost impossible to check its progress. On the other hand, if the seedlings are a fair distance apart, there is not so much chance of them being overwatered. Even should this happen, and if the disease appears, by pulling out a few seedlings round the infected ones, and placing the seed box or pan in a light, airy position, the disease may be
effectually checked. In this case, as in all others, "pre-
vention is better than cure"; therefore by giving good
drainage to the seed pans or boxes, by sowing thinly, and
by keeping the atmosphere in the proper condition, the
disease may easily be avoided.

CLUBROOT OR "FINGER-AND-TOE"

This is undoubtedly the worst disease that attacks
garden crops. The Clubroot of Cabbages, Cauliflowers,
&c., and the Finger-and-toe of Turnips are the same
disease, and are well known to gardeners and farmers.
The gardener or farmer has a great advantage,
however, over the cottager, in that he has plenty of
ground at his disposal which he can use for the
rotation of crops. It is a real hardship to the cot-
tager when this disease makes its appearance in
his garden, but if he under-
stood his plants better, and
also the diseases which
attack them, he would then be in a better position to
attack a disease immediately it made its appearance.

The disease is introduced into a garden or field either
by infected plants or by manure that has been carelessl
handled. Care should therefore be taken to see that fresh plants are free from this disease.

In the early stages the roots are seen to be somewhat swollen, having in places a gradual swelling. This swelling must not be confused with that produced by the Cabbage Gall Weevil, which is abrupt, and contains in the centre of it a small white grub. That produced by the Clubroot, however, is gradual, and in the young stage extends through the whole root. If such swellings are cut through with a knife they are found to be quite solid.

If the ground is infected with the spores of this disease, and perfectly clean and healthy plants are injured by insects, or by tools when working in the garden, some of the spores may come into contact with these injuries, and, entering the tissue, will there develop. This disease does not form hyphae or mycelium, but when the spore germinates it simply produces a gelatinous-looking substance, called plasmodium, which, as it grows, absorbs the contents of the cells, and also causes them to grow much larger. This plasmodium also goes from cell to cell, absorbing their contents in its course. New cells are formed, and these in turn become affected by the disease, until the large clubroot-shaped mass is formed at the root of the Cabbage, Cauliflower, &c., or the large swellings and nodules on the root of the Turnip.

When the disease is full grown it commences to form spores. This is done in a rather curious way. The plasmodium which has filled the cells simply forms itself into little rounded bodies or spores. By the time these spores are formed the swollen portion has begun to decay and the spores are liberated in millions into the soil.
Thus we see the necessity of checking this disease before it comes to the fruiting stage.

If we are in any doubt about our Cruciferous crop being attacked by this disease, we should watch the plants carefully on a bright, warm day, after some dull weather. If the plants are attacked, the leaves will begin to flag, for, the passage of water from the root being obstructed, enough cannot be sent up to take the place of that which is given off by transpiration. In healthy plants this drooping may only be slight, but should they droop badly one or two should be pulled up. If the disease is present, the whole crop should be gone over and all suspected plants pulled up and burned. This will prevent the ground being further infected by the spores of the disease. These spores will lie inactive in the ground for at least five years. If no plants of the Cruciferae tribe—either cultivated or weeds—are grown for four years, and then Cabbages are planted, these will be infected by this disease from the soil. Care must therefore be taken that no plants of this kind are cultivated, nor weeds of the same species, i.e. Shepherd's Purse, Charlock, Garlic, Mustard, &c., allowed to grow.

The infected soil should be dressed each year with from 14 to 28 lb. of quicklime per pole until the disease disappears. If farmyard manure is used, care must be taken to see that no infected plants have been carelessly thrown into it, or even that animals have not been fed on diseased plants or roots, or the disease will be spread wholesale.
ONION MILDEW

This is another serious disease, which sometimes does considerable damage to the Onion crop. It is first detected by the whitish-yellow patches on the leaves. This is caused by the mycelium or disease plant devouring the contents of the cells, thereby killing them and leaving nothing but the empty walls, which give the patches their characteristic colour. The bulbs are not attacked by this disease, but as the food is manufactured in the leaves, if these are attacked early, the bulbs cannot grow. As the mycelium matures, little branches are sent to the outside of the tissue of the leaves through the stomata. These bear little branches, each with a spore at the apex. These spores are produced in large numbers, and, being very minute and light, are blown about by the wind. Wherever one alights on a healthy Onion leaf, it immediately germinates, producing a little hypha, which enters the tissue of the leaf and produces another centre of the disease. Thus, in a very short time, the whole crop may be attacked. Not only will the original crop be ruined, but insects, birds, &c., may carry the minute spores to a neighbouring crop and thus infect them. The spores may also be carried by the wind for a considerable distance, and wherever they alight on healthy Onions they start the disease. There is another mode of reproduction. Towards the end of the season branches are given off which produce thick-walled spores that are able to lie dormant in the soil during the winter unharmed, and if they come into contact with Onions in spring, will germinate and again produce the disease, which in
turn produces the branches with thin-walled spores, and so on.

Now it is obvious to all that the proper thing to do is to take off the infected leaves immediately the spots appear, and burn them, or if the plants are badly affected, they should be pulled up entirely and burned to prevent its spreading. Onions should not be planted on the same ground the following season, and those grown in the same garden during that season should be dusted with a fine dusting of 2 parts of lime to 1 part of sulphur two or three times during the season to prevent any possible attack of the disease.

**PEA-SEEDLING BLIGHT**

The seedling Peas are sometimes attacked by a curious-looking disease. The young plants become yellowish or blackish in colour, and very soon die away altogether. This disease—like many others—is worse in wet seasons having warm and cold spells. The diseased plants are almost covered with little fruiting branches which bear a three-septate spore at their apex; these are blown about or carried by insects, and germinate, thus starting the disease on fresh young seedlings near.

The seed should never be sown too thickly, or the plants will be weak from overcrowding, and also from the want of sufficient food, and therefore an easy prey to the attack of the disease. The disease spreads most rapidly when the seedlings are crowded.

Spraying with a weak solution of Bordeaux mixture will be effective in preventing its spread and checking its progress.
TOMATO SLEEPING DISEASE

This is a terrible disease, and causes great damage where Tomatoes are grown extensively in the same houses year after year. Market gardeners who are almost compelled to grow their Tomatoes in this way suffer most; but, as the loss is so considerable, it would be better, in their case, to grow other, though perhaps less remunerative, crops in the houses for a few seasons until the disease was entirely stamped out. Great care should then be taken not to get the disease introduced into their houses again. This is a rather difficult matter where the seed has to be bought, as seed from diseased plants will produce diseased seedlings. But this could be overcome by demanding a guarantee that the crop from which the seed was taken was free from disease; if this cannot be given, seed should be procured elsewhere.

The disease generally first attacks the root, the mycelium making its way right into the centre of the root, gradually working its way up to the stem. The plants then droop and have a sleepy appearance, hence its name. In a short time the stem just above the soil becomes visibly affected. It is covered with a whitish substance, which, on close examination under the microscope, is seen to consist of little fruiting branches, which in turn are branched, each branch bearing a spore at its tip. When these spores are matured they fall off and germinate on the soil, sending out hyphae in all directions. Wherever these come into contact with young rootlets they enter into their tissue, and thence to the older roots and stems, ultimately producing spores again.
There is another method of producing spores by this disease. The same mycelium which produced the other spores produces branches of curved spores in very large numbers, which are able to germinate and produce the disease again very quickly. There is still a third method of reproduction. Sometimes the mycelium in the soil gives rise to resting spores, which are able to lie dormant in the soil during the winter, germinating in spring, and forming a mycelium in the soil the hyphae of which may penetrate into the young rootlets of Tomatoes, devouring the cell contents, afterwards absorbing the walls of the cells which lie in their way until they reach the stem, where they send out their fruiting branches and spores.

Now as this disease can live in the soil for some time before it enters the plant roots, it must draw its food from the decaying matter of the soil; therefore it is a saprophyte, that is, one that lives on dead matter part of its life, and, of course, when it enters the plant it becomes a parasite, one living on living things. From what we have just learned about this terrible disease we at once see how difficult it is to deal with it, and how easily those who do not understand may be mistaken, thinking they have two or three different diseases when in reality they have only one.

There is no known cure for this disease. The seed should always be procured from a pure stock, as if the seed is saved from diseased plants, though not apparently showing the disease, some of the mycelia may be in a resting form in the seeds, which will become active with the germination of the seed and thus infect the crop.
If any plants show signs of the disease, they should be rooted up at once before the disease has time to produce its spores, taking care to take out every bit of root and to give the soil where they came from a good dressing of quicklime, mixing the latter with the soil. If by any chance the disease should get a hold in the house, the whole of the soil should be taken out when the crop is cleared, and mixed with quicklime or burned, and the houses, woodwork, &c., soaked with iron sulphate. Other crops than Tomatoes should then be grown in the house for a season or two.

**APPLE-TREE CANKER**

This is a very bad disease either in the orchard or cottager's garden, but it is—to some extent at any rate—preventable. The disease generally makes its entrance into the tree at a wounded part, where the more tender tissue is laid bare, such as where careless people have climbed the tree with nailed boots in gathering the fruit or in pruning. If a spore alights on such a wound it immediately germinates, the hyphæ obtain plenty of food from the injured cells to begin with, after which they make their way into the tissue of the tree. When once inside, the mycelium runs in all directions through the tree, devouring the contents of the cells and destroying the tissue. It is only when it bursts through the bark here and there on the tree that its presence is detected, but the mycelium may be making its way through considerable portions of the tree where it is never suspected at all. This is why the disease will break out in another
place even when we have cut an infected branch well back.

During the autumn little white cushions are formed at the points where the mycelium or disease plant seems to be strongest, eating away the tissue of the tree. These little cushions produce very tiny spores on their surface, which, when they are matured, germinate at once, extending the disease; or they may be carried by the wind some distance—being very small and light—or by insects, or on the feet of birds, &c. Wherever a spore alights on a wounded part of the tree it at once germinates, forming a small hypha which gradually develops into the mycelium or disease plant. Then, in the spring, if those parts where the disease has broken through the bark are examined carefully, little red points will be seen here and there. If one of these is taken off, together with a piece of the bark, placed between two pieces of pith, and sliced with a razor, and the extremely thin slices examined under first the low, and afterwards the high, power of the microscope, they
will be found to consist of a little case (or perithecium), inside which will be seen tiny club-shaped pouches (asci), each containing eight spores. There will also be seen numerous hairs or paraphyses. When the ascospores are matured, the perithecia open at the apex and the asci burst, liberating the spores in great numbers. These may be scattered in the same way as the other spores (conidia) mentioned above, and wherever they alight on a wounded part of the tree they germinate and produce the disease.

Now, from what we have learned of this disease, it will be seen how difficult it is to eradicate it where once it has got a hold of the tree. The hyphæ, which form the mycelium or disease plant, run right through the tissue of the branch, or even, in badly infested and neglected trees, right through the tissue of the whole tree, bursting out here and there, causing other sources of infection for healthy trees.

Where only one or two small portions of the disease appear, the branch should be cut well back. But where the tree is badly infected it ought to be cut down and burned.

Great care should be taken not to have the trees wounded in any way, and especially in the autumn and spring, when the conidia (spores) and the ascospores are matured. If by accident the trees get wounded at these times the wounds should be coated over with tar, or a good paint, to prevent the spores from settling in them and germinating.

The bark of the tree, like the bark and epidermis of many other plants, is proof against the attack of this disease; it is only where the tender tissue is laid bare that the disease will gain entrance to the tree.
Not only do Apple trees suffer from this disease, but the Beech, Oak, Hazel, Ash, Hornbeam, Maple, and Bird-cherry are all said to be subject to its ravages. Therefore it is most difficult to keep trees free from the disease, unless care is taken to prevent them being wounded in any way.

APPLE SCAB

This is another dreaded disease of the Apple, which does considerable damage both to fruit and tree alike. The mycelium of the disease creates most of its damage in the superficial tissue of the leaves and fruit, forming dark-brown or black spots where the tissue is destroyed. When matured, the cuticle of the leaf or fruit is ruptured, and great numbers of very minute branches grow out into the atmosphere, each one producing a spore or conidium at its apex. When these conidia are matured they drop off and germinate, producing a little hypha, which makes its way into the tissue of the leaf or fruit, there to develop into the disease again.

The minute conidia (or spores) may be blown about by the wind, or they may be carried by insects or on the feet of birds, &c. The disease is perpetuated during the winter by the resting mycelium, which springs into active growth when the warm weather returns in spring and the young leaves burst out of the bud.

When badly infected, the trees themselves suffer as well as the fruit, as the leaves are partially destroyed, and it is by the leaves that the food of the whole tree is manufactured. The diseased leaves and fruit should be carefully
collected and burned. The following season precautions should be taken to prevent the disease getting a hold, rather than trying to cure it after it has started. This should be done by spraying with Bordeaux mixture three or four times during the season. The first spraying should be done just before the flower buds open; the second just after fertilization has taken place, that is, when the petals drop; and a third when the fruit has grown very slightly. In warm, damp seasons, which favour the growth of the disease, a fourth spraying may be done in another fortnight's time. The Bordeaux mixture should be slightly diluted, because if put on at full strength when the leaves are so young some injury may be done to them.

PEAR SCAB

This disease is thought by some to be exactly the same as the Apple Scab, but others, again, believe that, though it is very nearly related to the former, it is a distinct disease. It acts in very much the same way, forming the dark-brown or black spots on the leaves and fruit. In some seasons which are warm and damp, and which favour the disease, some Pears suffer very badly; the tissue of the fruit cracks to a considerable extent, through the contents of the cells being devoured by the disease and the cells themselves drying up.

Diseased leaves and fruit should be carefully collected and burned, and the tree should be sprayed with Bordeaux mixture as advised for the Apple Scab.
PLUM-LEAF BLISTER

This disease is very easily detected in the Plum, as the leaves become blistered, the blisters being reddish in colour. Unlike many other plant diseases, the mycelium of this disease does not travel beyond the blister or outward appearance of it. Therefore it can be seen at once to what extent the trees are infected with the disease. Very tiny dark dots appear on the blisters about the end of June, and on examination under the microscope these little dots are seen to be the openings of little flask-shaped receptacles called spermagonia. Inside these little receptacles we find many curved bodies called spermatia. When matured, these spermatia exude from the mouths of the spermagonia in a sticky substance, which, when wetted with dew or rain, washes away from the spermatia, leaving them behind to germinate and produce new centres of the disease. These spermatia may be carried by insects to other healthy leaves or trees, there to start the disease, or the rain may wash them down on to lower leaves and thus infect the whole tree.

Towards the end of the season, perithecia are formed on the blisters. As in many other plant diseases, this form of fruit is not matured in the leaves while fresh and on the trees, but gradually during the winter. When the spring returns, and the young leaves burst out, the spores inside the perithecia are matured and liberated, being transferred to the young leaves through the agency of wind, insects, or birds, then germinate, thus producing the disease again.

If the trees are only slightly attacked by the disease,
the blistered leaves may be nipped off with the finger and thumb, and burned; but where this is not practicable the leaves should be carefully gathered when they have fallen, and burned, thus preventing the winter stage from developing, and the fresh attack in spring.

The leaves being the greatest sufferers, it is necessary to take active steps to eradicate this disease, as the food cannot be manufactured by them if they are badly diseased, and the whole tree will in consequence suffer.

STRAWBERRY MILDEW

This disease is not looked upon in the light it should be. It is generally attributed to a wet season or badly bedded plants, &c. But it is a disease which ought to be checked as much as any other plant disease. It is only too well known by those who grow this fruit, especially when it attacks the fruit itself. This, however, is not the first stage. It first makes its appearance in the leaves, where it forms a delicate white mycelium, afterwards passing on to the fruit, where it destroys the tissue by devouring the cell contents, leaving simply a decaying mass. When the fruit is attacked it is the ripest that first suffers, but in warm, wet seasons, when the disease attains its greatest luxuriance, it attacks all kinds of fruit, from the very youngest to the fully ripe, doing enormous damage. When the disease has matured it begins to produce fruit. This is very well known, in appearance at least. Little branches are sent out into the atmosphere bearing conidia or spores; they are produced in countless numbers, and, of course, are blown or carried about by the wind, insects,
&c., and wherever one alights on a young leaf or fruit, and the conditions are favourable, it immediately germinates, forming a new centre of the disease.

When this disease makes its appearance the beds should be gone over thoroughly, and all diseased fruit and badly diseased leaves removed and burned. This will prevent the summer stage of the disease spreading, and minimize damage to the crop. Every time any ripe fruit is picked, the others should be carefully looked over where the disease has made its appearance. This will prevent it spreading to the other fruit so rapidly.

Towards the end of the season, ascospores are formed within asci; these spores are able to lie dormant during the winter, germinating in spring, and infecting the leaves with the disease again. If a young plantation of Strawberries is attacked with this disease, the following spring the leaves should be dusted every week with lime and sulphur, 2 parts of the former to 1 of the latter. This will prevent the growth of the disease in the leaf, and prevent it attacking the fruit.

If, however, the plantation has fruited two or three seasons, the plants may be chopped off in dry weather after fruiting, and burned, a fresh plantation being made elsewhere with quite healthy plants.

**AMERICAN GOOSEBERRY MILDEW**

This is another disease which of late years has caused considerable damage in some districts. It is spreading only too rapidly, and is another instance of a fuller knowledge of plant diseases being required by the ordinary
person with a small garden, or even by gardeners with the charge of larger gardens, so that they may detect a bad disease at once, and check it before it has time to spread to any considerable extent.

It attacks the young leaves and buds, which are gradually covered with the delicate hyphae of the disease. These penetrate into their tissue, devouring the cell contents, destroying the cells and the apex of the shoots. It also spreads to the young fruit and gradually destroys it. When the disease has made some growth it produces enormous numbers of small white spores or conidia; these may be blown about by the wind, or carried by insects or birds to healthy branches or bushes, and under favourable conditions will germinate and produce other centres of the disease. When the bushes are badly attacked, the shoots are deformed at the apex, and the leaves shrivel up and die.

If there is only a slight attack, the tips of the shoots may be cut off and burned, the bushes being afterwards sprayed with potassium sulphide. The following season the bushes should all be sprayed just before the buds expand, and again, once a fortnight, until they are quite free from the appearance of the disease.

ROSE MILDEW

This disease is only too well known by the damage it does to the Rose bushes in many gardens. But when once it is thoroughly understood its attacks may be considerably checked. It attains its greatest luxuriance in warm, damp seasons, therefore in such seasons special
precautions should be taken to guard against it getting a hold of the bushes.

The leaves and young shoots become covered with a delicate white mycelium, the hyphae of which penetrate into the tissue of the leaves or shoots, and live on the contents of the cells. If it is a bad attack, the leaves and shoots become covered with a felty substance, the hyphae being interwoven into practically a solid mass. On this mycelium great numbers of conidia are formed, which may be scattered by the wind, &c., and wherever one alights under favourable conditions it will germinate, produce a short hypha, and, later, a close felty mass of mycelium and conidia again.

Most people who grow Roses are familiar with this disease, how the leaves curl up and drop prematurely, when practically all the nourishment of the cells has been devoured and the tissue destroyed.

As the season advances, another kind of fruit is produced in perithecia, which are sunk in the mass of mycelium. In these perithecia, asci containing ascospores
are formed. These ascospores germinate on the bushes the following spring, and give rise to the disease again.

Now such a bad disease must be kept in check by all means possible, or the bushes may be practically ruined by it. The diseased parts may be dusted over with sulphur and quicklime, 2 parts of sulphur to 1 of lime. This is very effective, but it leaves the bushes rather unsightly, and for this reason is not so much used, especially where the bushes are grown in prominent positions. The bushes affected may be sprayed with potassium sulphide, which does not make the foliage so unsightly, or they may be sprayed with Bordeaux mixture—the paste form being used—which does not leave a deposit on the leaves. If the bushes are badly attacked, the affected shoots and leaves may be cut off and burned before the winter ascospores are formed; this will keep the disease in check another season.

If the season is favourable to the spread of this disease the bushes should be sprayed with Bordeaux mixture after the first crop of flowers is cut; this will keep the disease in check considerably in the autumn, the time most dreaded for this disease.

**HOLLYHOCK RUST**

This disease made such strides among the Hollyhocks that it was found almost impossible to grow these plants in some places. It is well known in appearance to all growers of these majestic plants. The leaves become yellow, and are soon covered at intervals with brown, hard, wart-like outgrowths. These spread to the stem,
SPRAYING CARNATIONS
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and even to the base of the flowers themselves. On cutting sections of these warts, or on placing one on a microscopic slide, breaking it up, and examining it under the microscope it is found to consist of clusters of spores, which are called teleutospores. They are peculiar in that they are divided into two by a partition through the centre. These spores germinate, again producing the disease, but those formed later in the year remain dormant during the winter, and when the young shoots grow out in the spring, germinate, and start the disease afresh.

As soon as the disease makes its appearance the leaves affected should be taken off and burned. Should it unfortunately get a hold, the plants should be sprayed with Bordeaux mixture, and the following season, just before the stems are sent up, the crowns should be sprayed with the mixture, and again at intervals of ten to fourteen days, as required to keep the disease in check.

On no account should any of the diseased leaves be left on the ground, or put into a heap and left. They should be gathered and burned. By the careful application of Bordeaux mixture, and attention to collecting the diseased leaves, the Hollyhock may be grown almost anywhere with considerable success.

To have lost such noble flowering plants from the garden through disease would have been a loss not easily replaced.

CARNATION RUST

This disease in some seasons causes considerable injury to these lovely plants in the garden. The first appearance of it is when the leaves begin to turn yellow through the
disease devouring the contents of the cells, leaving them quite dead. On examination of such leaves little dark-brown raised spots are to be seen. These, when placed under the microscope, are found to be clusters of spores. These spores germinate very quickly, and may be carried by insects, birds, &c., and deposited on healthy plants, where they speedily establish the disease. There are two kinds of spores produced by this disease, as also by many others, viz. teleutospores and uredospores, but in this disease they may frequently be found growing together in the same clusters.

If the disease is suspected, the plants should be gone over occasionally, and all leaves which are turning yellow should be removed and burned before the fruiting stage is reached; this will check the disease, and prevent it spreading to other healthy plants. For outside carnations that are badly attacked, spraying with dilute Bordeaux mixture has been found effective, while for special plants, or those grown under glass, spraying with potassium permanganate solution of a rose-red colour will keep the disease in check. In growing Carnations under glass, special precautions must be taken to give the plants plenty of air on all suitable occasions; for if the atmosphere gets at all stuffy, or the plants receive a check, the disease will very soon cause sad havoc among the plants. The disease also attacks allied plants, many of which are weeds, such as Chickweed, Spurrey, &c., therefore care should be taken to keep the garden perfectly free from such weeds where this disease is prevalent.
VIOLET RUST

This disease does not cause very great damage to the plants growing in the open borders, except in damp, cold seasons, which check the growth of the plants, and which favour the spread of the disease. But in damp, mild seasons, if the disease attacks cuttings in the frames, it sometimes does considerable damage, destroying the half-rooted cuttings wholesale. This trouble is not experienced to such an extent in districts where the cuttings can be struck outside.

The disease first makes its appearance as little black spots caused by the mycelium devouring the contents of the cells and destroying them. The uredospores are then formed, and after a time the teleutospores are formed, which are of a dark-brown colour, and appear in small clusters here and there on the leaves. Of course the fruiting stage is the last stage of the disease. The mycelium, being inside the host plant (Viola), is secure from any substance which may be applied to cure it. If, however, there is any fear of attack, the plants may be sprayed with dilute Bordeaux mixture or Condy's fluid. This will not cure the disease, but may prevent it spreading to other healthy leaves or plants.

CHRYSANTHEMUM RUST

This is another disease which at one time was thought to be of far greater importance than it is now. This is owing to the energetic efforts which were put forward at the time of its first appearance to stamp it out, efforts
which have had such good results that there is now little fear of serious harm from attacks of this disease.

The mycelium of this disease runs through the tissue of the leaves, sending out clusters of spores here and there on the surface. The summer spores are known as uredospores, and are produced in large numbers, germinating quickly, and soon covering the leaves with the disease if not checked.

Later in the season, when the leaves are dying off, the teleutospores, which are able to exist through the winter, are formed. Should these come into contact with Chrysanthemums in the spring, they germinate at once, and produce the disease. The leaves of all diseased plants should be carefully collected and burned, to prevent the teleutospores from again causing the disease in spring.

If the disease is suspected, the plants should be sprayed at intervals with potassium sulphide, and any which show the disease should be taken from among the rest, and either treated separately or burned. Where the plants are grown inside, in the shelter of a glasshouse, the uredospores may be produced all the year round, but special spraying should be done, where the disease is suspected in these plants, to keep it in check.

BACTERIAL DISEASES

Bacterial diseases in plants are becoming known, and are much more difficult to deal with than the ordinary plant diseases, which to a certain extent live on the surface of the plants, or at least produce their spores on the surface, and can therefore be treated with fungicides and destroyed.
Bacteria, however, when they get inside the host plant, are able to live and multiply in unlimited numbers without ever coming to the surface at all. At present there is no known cure for such diseases. The only thing to be done is to burn any diseased plants, being careful to destroy every part of them and thus prevent any further attack. No part of them should be used for propagating purposes, and every effort should be made to destroy insects that have fed on them, lest they go to healthy ones, carrying the bacteria with them, and in this manner inoculating those plants that were previously free from the disease.

The epidermis of plants, like our own skin, is proof against the attack of disease germs, but when once the epidermis is broken the tissue is laid bare to the attack of these organisms. When once the bacteria get inside the tissue, they begin to feed on the contents of the cells. Not only do they feed on the cell substances, but they set up changes in these substances which are highly injurious to the plants, and which to a great extent bring about their destruction. Some diseases produce similar effects in animals and men. The germs (bacteria) produce a toxin which is the direct cause of the disease. To counteract this, science produces an antitoxin, which, if successful in its action, cures the patient, but if not, is fatal. Hence for such diseases in plants we must try to find an antitoxin which will destroy the disease from within, as the application of fungicides from without has practically no effect on these bacterial diseases. It would be just as absurd to expect to cure a person suffering from typhoid fever by washing him with disinfectants, as
to think of curing a plant suffering from bacterial disease by spraying it with a fungicide.

There is a wide field for research in connection with these plant diseases. There is no absolute proof that diseases in animals and men are not able to infect plants, and afterwards to infect animals and men again. It is absolutely certain that some disease germs (bacteria), such as *Bacillus tetanus*—the germs of lockjaw, &c.—are able to live in the soil, and directly infect animals and men from it. Serious research work in this direction should be undertaken at once.

**Potato Bacteriosis**—This disease has been studied by Dr. E. F. Smith. Its first appearance is detected by the shrivelling up of the leaves, after which brown streaks are to be seen in the stem, showing the progress of the disease, which passes down into the tubers (or underground stems). Here a brown ring is first formed round the tuber, a short distance from the outside, and this gradually becomes broader until the whole inside of the tuber is a mass of powdery substance, which simply teems with the germs of the disease (bacteria). If nothing has been done to stop this disease before this time the skin breaks and the bacteria are liberated into the soil, there to lie dormant until the next opportunity presents itself for entering the tissue of other potatoes, and starting the disease again. The bacteria multiply at an enormous rate. They consist simply of one cell when full grown, and multiply by dividing into two by the formation of a cell wall through the middle of the cell. These two divide again, and so on. This, going on very rapidly, causes them to increase enormously, but when
adverse conditions arise, this multiplication stops until the conditions become more favourable for their growth again. All plants showing signs of this disease should be carefully dug up and burned, before there is any chance of the bacteria being liberated into the soil, and care should be taken not to injure the stems or tubers in soils where the disease has at any time been. Insects should be kept down also where the disease is feared, to prevent them carrying the germs and inoculating healthy plants.

One example of such diseases must suffice for such a work as the present one. Very little has been done up to the present. The enormous difficulties in the way of carrying out experiments are responsible for such a state of affairs, but it may be hoped the time is at hand when the work will be taken up and thoroughly investigated, and much money thereby be saved.

Only the fringe of this all-important subject of plant diseases has been touched upon here, but enough has been said to make clear the great need of a fuller knowledge of them being acquired by all those who have the cultivation of plants in their hands, not only for the sake of one's own plants, but also because a neighbour's plants may be infected by the spores of the diseases on plants in the vicinity. These spores are so very small and light that they practically float about in the atmosphere, and wherever one alights on a suitable host plant in the proper condition, with regard to moisture, &c., it germinates, creating a centre of disease from which the entire crop may be infected. Or, as has been explained, insects may carry them on their feet or bodies. Birds also may carry them on their feet or feathers, or even mammals, such
as cats, may carry them on their fur. Hence it is our duty to study the diseases of our plants and to take all steps necessary to keep them in check or to eradicate them.

The reader is referred, for a fuller knowledge of plant diseases, to Principal Ainsworth-Davis’s translation of Bruck’s *Plant Diseases*, Mr. George Massee’s textbook of *Plant Diseases*, and Dr. M. C. Cooke’s *Fungoid Pests of Cultivated Plants*. 
APPENDIX

NOTES FOR TEACHERS OF HORTICULTURE

I.—THE SCHOOL GARDEN

To make the teaching of Horticulture as thorough and as highly educative as possible the greatest care should be exercised in making the arrangements for planning the school garden.

Where the headmaster or an assistant is qualified to teach gardening it is very desirable that the class should be under his charge, but where this is not the case, a thoroughly good local gardener should be employed for a year or two, with the assistance of the school teacher under whose charge the class would ultimately be placed. The teacher can assist the gardener by maintaining discipline, and helping to correlate school work with the gardening operations. He would, at the same time, be qualifying himself to take charge of the class. This should be supplemented by special studies for a season or two.

The size of the garden should be carefully considered by the county instructor and the schoolmaster before anything further is done. The county instructor should consider the position of the ground—which in all cases should be near the school—the shelter, and the nature of the soil, while the schoolmaster should furnish details with regard to the boys or girls, as to their industry and enthusiasm, &c. No more should be attempted than can be carried out successfully by the class. There is a tendency, by those who do not understand the great amount of work necessary to teach gardening successfully, to cram too much into the time at the disposal of the gardening class. The consequence is that a great amount of the educational value of gardening is lost. From one to two hours a week is not a long time in which to get out the tools for fourteen
boys or girls in a methodical manner, to give some instruction in the method of handling the tools, and the reasons for doing the operations concerned. Again, before the conclusion of the time at the disposal of the class, the tools must be cleaned thoroughly, and put into their proper places in good order. Thus it will be seen that there is not very much time left for the actual work in the garden, and if the boys and girls have to be constantly urged on with their work, to get it completed in time, they have no time for observing the effect of various influences on their crops, insect pests, or diseases, and their work, instead of being a pleasure, becomes a drudgery. Hence the educational value of gardening will be lost entirely.

The garden should be a school garden, not simply a long row of square plots, or even a double row of square plots. What interest can children take in such an arrangement of square pieces of ground, though set out quite neatly? There must be some artistic, though quite simple, arrangement of the plots, by which the plots may all be perfectly separated, yet grouped so as to give the appearance of a garden as a whole. Tidiness is one of the principal features of a garden, and if the boys understand that on each one of them depends the good appearance or otherwise of the whole garden, they will take a far greater interest in their work. Again, if they realize that if a crop fails on one plot the whole garden is disfigured, they will each put greater care into the sowing of their seeds, the thinning of their crops, hoeing between, and all the other operations required. In fact the whole work is raised to a higher level.

Where the individual-plot system is adopted the plots should be 1 pole—30½ sq. yd.—in extent each, with a small seed or nursery plot, and a small fruit plot. The centre or main paths should be 3 ft. wide, while the side ones should be from 1½ to 2 ft. wide. They should be edged, preferably with stones, which, if displaced, can be easily put straight again. Living edgings, such as London Pride, Box, &c., are not suitable for school gardens, as, even with careful attention, the children do not understand properly how to handle their tools, and the edgings get damaged and patchy and do not look well. Wood is very good, but expensive, and after a time it begins to decay; it then gets broken, and looks unsightly. But stones, when once procured—if not to be found on the ground—are permanent, and with a little care can always be kept tidy.

The paths should be partially, but not permanently, made. This should be explained when laying out the garden, as the arrangement of the garden should be altered every few years. This will be experience for the
Appendix

children in many ways—in drawing new plans and plotting out the ground from the plans, in making paths, &c.—and it will make it more interesting to the neighbourhood generally. The school garden ought to be a place of interest to the whole village—as it is in many instances. The villagers should be interested in it, and then if they see that it is deserving of encouragement they will purchase the produce more readily, and in other ways contribute to its success, probably giving prizes at the local flower show, or for the best-kept plot, &c.

Where the school is a small one, and there is not a sufficient number of boys of the proper age (over eleven years), seven plots instead of fourteen may be laid out, each plot being 2 poles instead of 1, with the additional seed or nursery bed and the fruit plot. Two boys, a senior and a junior, should be placed on each plot. Then by the time the senior boy leaves school the junior will have obtained a fair idea of how to manage his plot, and will be able to guide another boy, junior to himself. Therefore it will be seen that the system of larger plots with two boys on each has some points to recommend it, especially for small schools.

There is also the collective working of the school garden; that is, the boys or girls take part in all the different operations all through the garden. Where the garden is small this system has much in its favour; there are not so many paths required, and therefore not so much waste of ground. A small garden can also be kept tidier if not too much subdivided; the crops can be grown in larger quantities together, giving the children a better idea of cropping, and there is a better chance of securing the rotation of crops. Against all this must be placed the loss of individuality in the scholars. Again, some who are lazy are apt to take advantage of those who are more enthusiastic, and thus the energetic ones do not get the credit they deserve, as their work is lost amongst the others.

When the plots have been planned, and the paths made, the former should be trenched over where the soil is deep enough. Where the soil is not two spits deep no trenching should be done, as it will do a great deal more harm than good to bring up the subsoil. In the case of shallow soil, double digging should suffice; that is, an opening two spits broad and one deep should be taken out, then the next spit should be dug over in the bottom, kept there, digging into it various substances according to the nature of the subsoil; loam or clay and cow manure for sandy or gravelly subsoils, and road grit, half-decayed leaves, horse manure, &c., for clayey subsoils. In taking out the openings all unnecessary work should be avoided. Therefore the boys should be arranged so that one starts at one end of his plot.
and the other at the other end of his. No. 1 boy will lay his soil across the path on to No. 2 boy's plot, and No. 2 boy will lay his soil on to the other end of No. 1 boy's plot. Thus when No. 1 digs right to the end of his plot he will have the soil from No. 2 boy's plot to fill in his last trench, and No. 2 boy, starting from the opposite end, when he comes to the last trench will have the soil from No. 1 boy's opening to fill up with, and so on through the whole fourteen plots. This will save considerable time and labour, as it is not necessary to wheel the soil from the one end to the other of every plot. The boys cannot understand this arrangement at first—to hand over part of their soil to their neighbour seems strange—but before they have finished they see the idea and consider it a good one.

Where trenching can be done, the openings can be made in the same way, taking out two spits instead of one. This has many advantages. If the ground has been neglected for some time, and a great many annual weeds are growing on it, they are effectually destroyed by being buried in the bottom of the trench, and large numbers of their seeds are buried with them. On neglected ground there are always plenty of insect pests, as they can find refuge there without being disturbed; but trenching puts a great many of them down to a depth from which they cannot possibly climb, consequently they are destroyed. Trenching on deep clayey soils is almost essential, leaving it rough so that the frost may do its work of breaking the fine particles asunder and making a fine tilth for seed sowing in spring.

In digging or trenching, the boys should be made to do their work very neatly: not to come too close to the edging, of whatever kind it is; not to injure it if a living one, not to break it down if of wood, nor to move the stones or tiles if of these materials. They should always keep 3 in. away from the edging; but the surface soil, with weeds and their seeds, may be scraped off and put into the bottom of the trench. The spade should always be turned inwards when digging along the edging; if it is turned outwards the soil is sure to be scattered over the edging on to the path, and this should never be allowed. It may take some practice to get into the proper way of handling the spade; but, as with all other tools, the correct way should be insisted on, and when this has been acquired the work is much more easily performed. For instance, when digging, the spade should be put straight into the soil and pushed in with either left or right foot. The boy should be standing in such a position that the whole weight of his body is on the spade when pushing it in with his foot, and when it is embedded to the top of the blade he should be standing almost upright. This will rest his back; then, bending, he should grip the
lower part of the handle with one hand, while the other is in the eye of the handle, and turn it over, afterwards pushing it in straight again, and so on.

It is always well to get the work well in hand in the early winter, in the garden, as there may be a considerable amount of weather entirely unsuitable for outdoor gardening during the later winter months. This time can be profitably used in putting in order any tools which may require it, &c., and for having some talks over the work which has been done, and that to be done, in the garden. This is the time and opportunity to make gardening of real value as an educational subject to the children, an aspect of which more will be said in the next section.

Before we proceed further, we may here consider what tools are necessary to carry on the school garden successfully. We must take into account the nature of the work, the season of the year for which each set of tools is required, and to some extent, also, the nature of the soil. No absolute hard-and-fast rule should be laid down with regard to the supply of tools. It would, of course, be better for each boy or girl to have a complete set of the principal tools. The initial cost would be great, but the advantages would far outweigh this, and in the end this plan would probably prove the most economical. Each boy or girl could have his or her set numbered to correspond with the number of the plot. He or she would then be responsible for the set—if one was put away dirty, by any chance, the boy or girl could be found at once who did it; or if a tool got broken or damaged, the blame could be put upon the right person at once. The implements would also last longer, and there would be no vexatious waiting for tools at a busy time. The following is a complete list, with cost, of tools required for a class of fourteen children:

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spades, at 2s. each</td>
<td>14</td>
<td>£1 8 0</td>
</tr>
<tr>
<td>Forks, at 2s. each</td>
<td>14</td>
<td>1 8 0</td>
</tr>
<tr>
<td>Draw hoes, at 1s. each</td>
<td>14</td>
<td>0 14 0</td>
</tr>
<tr>
<td>Dutch hoes, at 1s. each</td>
<td>14</td>
<td>0 14 0</td>
</tr>
<tr>
<td>Rakes, at 1s. each</td>
<td>14</td>
<td>0 14 0</td>
</tr>
<tr>
<td>Dibbers, at 6d. each</td>
<td>14</td>
<td>0 7 0</td>
</tr>
<tr>
<td>Trowels, at 6d. each</td>
<td>14</td>
<td>0 7 0</td>
</tr>
<tr>
<td>Garden lines and reel, at 2s. each</td>
<td>2</td>
<td>0 4 0</td>
</tr>
<tr>
<td>Billhook, at 2s.</td>
<td>1</td>
<td>0 2 0</td>
</tr>
<tr>
<td>Wheelbarrow, at 15s.</td>
<td>1</td>
<td>0 15 0</td>
</tr>
<tr>
<td>Brooms, at 1s. each</td>
<td>3</td>
<td>0 3 0</td>
</tr>
<tr>
<td>Watering cans, at 2s. 6d. each</td>
<td>3</td>
<td>0 7 6</td>
</tr>
<tr>
<td>Syringe, at 7s. 6d.</td>
<td>1</td>
<td>0 7 6</td>
</tr>
<tr>
<td>Tool shed, at £3, 5s.</td>
<td>1</td>
<td>3 5 0</td>
</tr>
<tr>
<td>Pruning knives, at 2s. each</td>
<td>2</td>
<td>0 4 0</td>
</tr>
</tbody>
</table>

Total                                  |         | £11 0 0 |
The care of the tools should be one of the first considerations. Sufficient time should be allowed for each boy to clean his tools thoroughly. For this purpose a large vessel of some kind should be procured—an old trough or disused small bath—for holding water, so that several boys may wash their tools at the same time. Old rough brushes should be at hand also, if possible, for taking off the rough soil—after they have been scraped with a piece of wood. When they are thoroughly washed they should be dried and rubbed with an oily rag, to prevent rusting. This should be done under the personal supervision of the teacher. He should also stand at the shed and see that the tools are all put into their proper places. One boy may be inside the shed to take the tools at the door from the others and hang them up. The shed should afterwards be swept out. All this seems to take up considerable time, but it is only when such details are carefully attended to that the highest educational value is obtained from gardening.

The arrangement of the crops on the plots or garden should also receive careful attention, and should be considered long before planting or sowing time arrives. The first consideration, of course, will be the nature of the crops, and their position in the plot or garden to ensure their highest development. As a secondary consideration, the appearance of the garden should be taken into account, and where the garden can be improved by placing a certain crop in a certain position—without inflicting any injury on other crops—this should not be lost sight of. For example: sow Beetroot, with its purple foliage, behind a row of brightly coloured annual flowers. It was desired to make a vegetable bed effective as well as useful. It measured 36 ft. by 7 ft. Accordingly, a row of Parsley was sown all round it, 1 ft. from the edging stones; then a row of Beet, 1 ft. inside that; and two lines of Carrots in the centre, connected at the ends. The various coloured foliage had quite a good effect.

The rotation of crops must be arranged for as far as is practicable in the small area of ground available. This, of course, can be much better carried out on the common plot. Sometimes this matter is carried to excess. Plots have been set aside for a single vegetable, such as a plot of Beet, one of Cabbage, one of Cauliflower, one of Carrots, one of Turnips, and so on. Now, undoubtedly the system of rotation can be carried out perfectly in this way, but it is done at the expense of the loss to the children of a general knowledge of the cultivation of garden crops. As the same boys or girls seldom stay more than two years in the gardening class, at the end of this time they would know all about the management
of two crops only, with a hazy idea of the management of the others, gained from observation of the other children at work. The "general system" of cropping must be the one adopted, and every advantage must be taken of the land available; the rest may be explained to the children as the work proceeds.

Intercropping should also be done as far as possible, the children being taught—from experience—to take the full value of the land, such as planting Greens between the early Potatoes, or planting early and late Cauliflower alternately. The early ones, not being so strong growing, will be cleared off in time to allow the late ones to develop. Cauliflower may also be planted between the early Lettuces. Early Turnips may be sown, or Lettuce may be planted on the ridges between the Celery trenches, and so on. No patchy planting or sowing should be allowed, such as small beds of Lettuce, Radish, &c.; the crops should be sown or planted in rows, and should run the whole length or breadth of the plot.

The table on p. 360 may be taken as a general idea of the cropping of a plot 30 ft. by 9 ft., 30 sq. yd. or nearly 1 pole. The dotted lines are for intercropping Winter Greens and Brussels Sprouts.

Manuring should be done in a thoroughly practical manner. For a garden of \( \frac{1}{4} \) acre, 4 or 5 tons of farmyard manure should be allowed, for smaller gardens, less in proportion. There should also be a small quantity of the principal artificial or chemical manures procured, such as nitrate of soda, superphosphate, and sulphate of potash, and a little good mixed manure, such as Thomson's Vine Plant and Vegetable Manure, to give the children a thorough idea of this all-important subject of manuring the land. This will lead to considerable expense, but it is educational, and therefore expense should not be considered.

The subject of the disposal of the produce from the school gardens is of great importance, and ought to be considered in a different way from what it is at present. In some counties the produce is given to the children as a reward for the work they have done in the gardens. In others the produce is sold to local people, and half the amount realized is given to the children as a reward for their work.

As there is a considerable initial outlay in starting a school garden, in supplying land, tool shed, tools, &c., and also a considerable annual outlay for seeds, manure, labels, pea sticks, repairs to tools, rent of land, &c., it is only reasonable to expect the County Councils to desire some monetary return for all this expenditure. The great difficulty arises in the disposal of the produce. School gardens are usually situated in country districts,
<table>
<thead>
<tr>
<th>Plant</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parsley</td>
<td>6 in.</td>
</tr>
<tr>
<td>Winter Greens</td>
<td>2 ft.</td>
</tr>
<tr>
<td>Brussels Sprouts</td>
<td>2 ft.</td>
</tr>
<tr>
<td>Potatoes</td>
<td>2 ft.</td>
</tr>
<tr>
<td>Brussels Sprouts</td>
<td>2 ft.</td>
</tr>
<tr>
<td>Peas</td>
<td></td>
</tr>
<tr>
<td>Radish followed by Cauliflower</td>
<td>2 ft.</td>
</tr>
<tr>
<td>Cabbages</td>
<td>2 ft.</td>
</tr>
<tr>
<td>Broad Beans</td>
<td>2 ft.</td>
</tr>
<tr>
<td>Parsnips</td>
<td>$1\frac{1}{2}$ ft.</td>
</tr>
<tr>
<td>Turnips</td>
<td>$1\frac{1}{2}$ ft.</td>
</tr>
<tr>
<td>Dwarf Beans</td>
<td>$1\frac{1}{2}$ ft.</td>
</tr>
<tr>
<td>Onions</td>
<td>$1\frac{1}{2}$ ft.</td>
</tr>
<tr>
<td>Onions</td>
<td>1 ft.</td>
</tr>
<tr>
<td>Leeks</td>
<td>1 ft.</td>
</tr>
<tr>
<td>Cabbage Lettuce</td>
<td>1 ft.</td>
</tr>
<tr>
<td>Carrots</td>
<td>1 ft.</td>
</tr>
<tr>
<td>Carrots</td>
<td>1 ft.</td>
</tr>
<tr>
<td>Cos Lettuce</td>
<td>1 ft.</td>
</tr>
<tr>
<td>Beet</td>
<td>$1\frac{1}{2}$ ft.</td>
</tr>
<tr>
<td>Beet</td>
<td>$1\frac{1}{2}$ ft.</td>
</tr>
<tr>
<td>Flowers</td>
<td>1 ft.</td>
</tr>
<tr>
<td>Flowers</td>
<td>6 in.</td>
</tr>
</tbody>
</table>
Appendix

where such produce is not required by the villagers, who have gardens of their own growing similar produce. Instances, however, often arise where the residents will buy the school garden produce, and will even pay fancy prices for it. A boy has been known to make 7s. 6d. off 1 pole of ground in a school garden. This, of course, is quite exceptional. When the school garden is started, good prices are often paid for the produce, not for the sake of the produce, but to encourage the boys in their work. After a year or two the prices drop, and sometimes the produce cannot be sold at all. The goods are produced in such small quantities that it would not pay anyone to go to one garden for them. One way which seems satisfactory is a system of collecting the produce from all the school gardens with a light motor van, and conveying it to market. This will not pay while the school gardens are so far apart, but when every school has its school garden there is no reason why the system could not be carried out successfully, and the proper market prices obtained for the produce. To make out a balance sheet from the school gardens at the present time, simply on the prices obtained locally, may be very misleading to the children, and also to those in authority, who might not understand the conditions of the various neighbourhoods. It might very naturally be thought that a garden class which sold £2 or £3 worth of produce was being very much better cultivated, and gardening being much better taught, than where there was only 10s. or 15s. worth of produce sold; whereas the one class might be quite as well taught as the other, but not situated in a neighbourhood where the produce was required. The fairest way is to value the produce and compile a balance sheet from that valuation.

Fruit culture should be adopted wherever it is possible, but not to an extent beyond that which can be managed comfortably in the time allowed for the class. A few trees may be bought for a quick return of fruit, but some stocks should be obtained, and either grafted or budded, thus allowing the children to see the method of cultivation of fruit trees from the beginning. The distances apart should be considered carefully (see chapter VI). Great care will be necessary with regard to the use of the pruning knife, and the working with tools among the fruit trees and bushes, not to injure either the stem or roots.

Flower culture should never be lost sight of in the school garden; in fact it should be a special feature. The garden should be laid out on artistic lines, but not too elaborately. A row or two of flowers, to mark out prominently the principal outlines of the garden, is very effective. A pretty garden is an attraction for everyone, and especially for school chil-
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dren. The writer has had experience of teaching in a school garden—if such it could be called—where there were only the regular oblong plots, like so many stalls in a stable, devoted to the cultivation of vegetables only. Can anyone wonder at the lack of enthusiasm and energy in the children in such a garden? But the change was magical when the arrangement of the plots was altered, and some flowers were introduced. The enthusiasm rose to a very high pitch, and there was no difficulty in getting even the roughest of the garden work done expeditiously. Some of the showy annuals are perhaps best suited for this work, such as Candytuft, Godetia, Linum, Nasturtiums (Dwarf), &c. For the side flower borders, perennials and biennials should be used, arranging them according to their height, time of flowering, colour of flowers, &c. The methods of propagation suitable for each kind should be carefully practised, and the flower borders should be kept tidy, and scrupulously clear of weeds. Nothing has so refining an influence on a person as the cultivation of flowers. No one can come into contact with such absolute purity as we get in some of the lilies, roses, carnations, &c., without being affected by it, or come under the influence of the perfume of the Mignonette, Sweet Peas, &c., without thinking of the loveliness of these flowers, and to think of anything lovely is to raise ourselves above the coarser part of our natures. Therefore flower culture should form a very prominent part of school gardening.

The children should be taught to keep their eyes open in the garden, to take notice of every detail in connection with the soil, plants, &c. They should be encouraged to talk to each other about their plots and their crops (not by any means idle gossip). In this way they can reason out things for themselves. In a school garden a boy was at a loss to account for something that had happened to his plants. Another volunteered an explanation, which, on further consideration by all, was generally accepted. Under such circumstances, it is wise for the teacher not to interfere, but he should keep his ears open, and if any wrong conclusions are arrived at, and accepted, he should correct them. The teacher should always encourage the boys to question him about their work, but he should not be too anxious to tell them all, or they will come to rely on him, and not use their own brains. He should rather question them further, and bring them to see the answer to their own question. This would encourage self-confidence, and make them think for themselves.

Gardening requires much thought and care. In all other trades and professions there are certain rules for guidance, or certain examples to
follow; but in gardening there are practically none, because what will do in one place will not do in another. Some soils suit one crop, some another; what is done in a cold wet spring cannot be done in a dry, hot spring, and so on. Therefore, to garden successfully, one must think for oneself, and to teach it successfully the children must be taught to think what they are doing and why they are doing it.

There are many things the children require to learn about their garden; the nature of the soil and the effects of the various methods of cultivation of it; seeds and seed sowing; germination of seeds; plants; parts of the plant and their uses for reproduction, for the food of animals, &c. Then there are the insect pests in the garden: how they make their appearance almost at once, and apparently from nowhere, and how to get rid of them. The plants are also subject to the attack of many diseases, as we have seen in chapter XVI. The children should be specially trained to detect the earliest signs possible of these diseases and how to eradicate them.

The time of the first year of the pupils in a gardening class will be taken up with learning thoroughly the methods of handling the tools, of cultivating the soil, of manuring soils, of sowing seeds, of thinning crops, of weeding, of harvesting the crops, and of generally tidying the garden or plot, together with all the manual work in the garden. In wet and unsuitable weather the instruction given in school should bear generally on those elementary principles, and thus establish a thorough foundation for the more advanced work in the second year.

In the second year, if the elementary principles have already been thoroughly grasped, both instructor and pupils will feel free to go more thoroughly into the reasons why certain operations should be done in certain ways, such as the digging of some soils in spring, the trenching of other soils in autumn, the bastard trenching or double digging of still other soils, &c. The methods of manuring certain soils with certain manures, and why—such as horse manure for heavy soils and cow manure for light ones; the method of sowing various seeds, thick and thin sowing, the advantages of each, the germination of seeds, the thinning of crops, and the reasons for such work, the reasons why weeding should be done thoroughly, &c., may all be taken during this term.

The harvesting of crops, how they mature, when they mature, and the methods of taking up and storing may also be taught. In the second year also a general idea of insect pests and diseases of plants should be given to the pupils. On wet and unsuitable days for work in the garden the instruction given in school should bear more on the reasons why the manual
work in the garden is done at various times and in various ways than on
the actual work itself.

In the third year the work in the garden should be easily and skilfully
performed by the pupils, who will understand tolerably well why they do
each operation as the time and seasons come round. They will also
observe with greater accuracy the results of the various methods adopted
in the cultivation of these plants, and should be able to give a fair explana-
tion of why a particular crop is doing well—the soil and season having been
suitable for it, and it being free from the attack of insects or from disease;
or to give an explanation for a particular crop not doing well—the seed may
not have looked very good; the seed time not have been suitable, either
too cold and wet, or too hot and dry; or the soil and season may not have
been suitable for it; or it may have been attacked by insects or by disease,
and so on. They should also be taught more fully how soils are formed,
and their composition with regard to plant foods, &c., how manures are
converted into plant foods in the soil, the composition of manures, and
their relative values. Artificial or chemical manures may be used, their
properties explained, and their action carefully watched.

Seeds may be studied more fully; testing for germinating power may
be done; the causes for failures sought for, &c. The plant should be
thoroughly studied as it grows in the garden. The uses of the various
parts should be carefully noted, such as the root to hold the plant in the
soil, and the root hairs at the apex of the rootlets to collect the food
materials from the soil, &c.; the stem to bear the branches, which in turn
bear the leaves. The structure of root and stem may be studied in wet
and unsuitable weather for work in the garden, the various parts detected
and explained by the aid of the microscope. Leaves, their function and
structure, how they breathe (respiration), how they give off the superfluous
water (transpiration), and how they take in part of the food of plants from
the atmosphere (carbon dioxide), and manufacture it into the substances
for use in building up the various parts of the plants (assimilation) should
also be taken.

The flowers, their parts, and the functions of each part—the calyx for
protection; the corolla for attraction, to attract insects to pollinate the
stigma; the androecium or stamens; and the gynæceum or pistil, for re-
production, to produce seed—is another subject.

The fruit, the parts of the fruit, and their uses; the seed, the parts
of the seed, and their function—(1) the testa or skin, for protection; (2)
the cotyledons or seed leaves, and the albumen to store and supply food for
the young plant; (3) the *embryo* or baby plant, which will produce the plant again on germinating—is another part of the third year's work.

The life-history of some common insects should be studied, tracing the insect from the egg to the larva, thence to the pupa, afterwards to the imago or perfect insect; the harm or good they do, and how to combat the harmful ones.

The life-history of some of the common plant diseases should be studied, from the germination of the spore to the production of the spores again. The third-year pupils may also cross-pollinate some flowers, with a view to raising new varieties with higher qualities than those in existence. Those pupils may not see the result of their work, but the third-year pupils the following season may carry it on, when they leave records of their crossings and their aims.

All this may seem a great deal to do at an elementary school, and under the present conditions it cannot all be done; but the education authorities are beginning to see the immense possibilities of the teaching of horticulture in our elementary schools, and there is no doubt that we are now at the commencement of a system of horticultural and agricultural education which will develop until we are able to give the rural population of our country as thorough an equipment in the way of education for their work as we now give the clerk, the engineer, the chemist, the lawyer, or the doctor.

In horticultural education the great point aimed at should be to blend the practical with the scientific, so that there is perfect harmony between science and practice. At present the gulf is too wide. The scientist will not condescend to associate himself closely with the practical man, and the practical man will not put into practice the theories of the scientist. Whereas, if the gulf was filled up, and scientist and practical man fraternized with each other, each seeking the other's welfare, enormous strides would undoubtedly be made. As the practical man, living so closely with Nature, has found out many things which are not revealed to those who only take an occasional glimpse into Nature's own great treasury, so the scientist has the knowledge which has been handed down to him for generations, along with that which he has himself acquired with the special means at his disposal. If the knowledge obtained in both ways were united, what further paths might not be opened to each one again, who might then go forward to better and higher things!

From such intercourse the scientist would not lose, but rather gain esteem from those he now wishes to help, while the practical man would
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not then be asked to do the unpractical things he is sometimes advised to try.

In the school gardens the foundation for such a happy result might be laid: the dignity of labour should always be upheld. The pupils should be taught not to be afraid to dirty their hands or their boots, the teacher himself setting the example; but they should always be taught to clean both hands and boots thoroughly when work is finished in the garden. If there is any broken skin, cuts, or bruises on the hands the children should not be allowed to work with them in the soil in case of germs entering the wounds.

The writer has had experience of pupils, not only in the school gardens, but amongst students of mature years, who thought it most humiliating to have to perform some of the menial operations in the gardens; but, needless to say, their objections met with little sympathy, and after some scruples were overcome the dreaded menial work was performed, which, to the astonishment of the students, raised them in the estimation of their fellows instead of lowering them. And so it should always be. There is a dignity in honest labour which should always be upheld.

II.—THE GARDENING CLASS

This class, when rightly conducted, may easily be made the most interesting in the school. The teacher has great opportunities, which, if thoroughly understood and properly utilized, may have far-reaching effects on the lives of his pupils. He has the whole of Nature at his command, and, if rightly interpreted to the children, may awaken in them a love of Nature which is always supremely interesting and of the highest educational value. Hence the teacher of the gardening class must always be a close student of Nature.

No amount of training will ever make a man a successful teacher of gardening unless he has the inherent qualities for such work within him. In other words, a teacher of gardening is born, not made. A man may go to a textbook and prepare a lesson on gardening, or he may even have had a thorough practical and scientific training in the art of gardening, but if he has not the art of teaching this subject in a bright and interesting manner, the interest in the garden will flag, the boys or girls will go through their work in a mechanical way, and it will gradually sink to the level of mere drudgery, when the educational value of it will be entirely lost. The successful teacher of gardening must have enthusiasm for the work, he
must have had a thorough and special training, and he must have the power of arousing enthusiasm in his pupils, so that they will feel a pleasure in doing any kind of work in the garden, even in hand weeding, when necessary.

When children understand that the weeds take up the food which would otherwise go to the plants, and that they keep out the light and prevent the food from being manufactured in the leaves by the aid of sunlight, then it is that they find a delight in pulling up the robbing weeds.

The teacher of the gardening class can drive home many beautiful lessons. He can, and should on all occasions, point out the dignity of honest labour. This he can do not in any direct way, which may defeat the object he has in view, but by emphasizing the lessons which will bear directly on labour. For instance, a child who seems to be afraid to dirty his or her fingers should have special attention for a time. The teacher should work with the child, doing, without hesitation, any part of the work himself, thus enabling the child to see, by example, that there is a certain amount of dignity even in the most menial operations in the garden.

The teacher of gardening can also open up the children's minds in a way which no other teacher has the opportunity of doing. He has the material to work with, and the children work with it also. Then, if the lessons are carefully thought out and properly taught to the children, they may have the very highest importance in their after life. For instance, he can show by actual living things, and things which they handle, how beautifully everything is arranged in Nature. How the rocks were first formed, afterwards decaying, forming soil on which it was possible for plants to live; these simple plants in decaying making it possible for other and higher plants to live. The higher plants then made it possible for animals to exist on the earth by producing plenty of food for them. Both plants and animals prepared the way for man to inhabit the world. Man, having dominion over all things in the world, and being endowed with reason, was able to subdue the animals and to take the plants and improve them as he desired. For instance, he changed the crab apple of our hedgerows to the beautiful apples of our gardens, the wild cabbage of some parts of our seashore, with its few leaves only, into the beautiful cabbages cultivated in our gardens; or the common wild rose of the hedgerow into the beautiful flower we so well know. As the plants used up the original plant food in the soil, the animals produced manure, which decayed and was changed into plant food in the soil again, thus making it possible for more and more plants to grow.
Even the atmosphere is laden with plant food, though we cannot see it, four-fifths of it being nitrogen, which when changed into nitrates is valuable plant food. The carbon dioxide which we breathe out is taken in by the leaves of the plants and changed into plant tissue, &c., while in the manufacture of these substances oxygen is given out by the leaves, which enables us to breathe and live.

In pointing out these lessons to the gardening class, which are all essential if the highest educational value is to be obtained from the teaching of gardening, the teacher can impress upon the children's minds the magnitude and the precision of Nature's laws, and how they could only have been arranged and maintained by a Power far above that possessed by man, viz. God, Who is all-powerful. This, of course, need not be thrust upon the children; but the teacher who has the children's welfare at heart will not hesitate to present a lesson to them in such a way that it will have a beneficial effect on their future life. Thus it may open up, in a very practical way, a subject which is at present, perhaps, only very imperfectly understood.

Thus we see the great opportunities and the great responsibilities of the teacher of gardening. He has the children at an age when they are most difficult to handle, between the ages of eleven and fourteen, when they know their time of school discipline will soon be at an end, and, being out of the classroom, they are almost inclined to throw off restraint. But a teacher who thoroughly understands gardening, and who is adapted for teaching, will have no difficulty in interesting his scholars in this class, and then, indeed, his task will be a light one. It will consist, in some cases, even in restraining the scholars and guiding them on the proper lines: the children become so anxious over their work, in such a hurry to see their garden free from weeds, that they may even hoe up the seedling plants, or in thinning their crops may be in such a hurry to get it done and get on with other work that they pull up the plants carelessly and leave the remaining ones with the soil too much loosened round them. The teacher will always have to be on the outlook for any hurrying over work and check it at once.

The children who should be taught gardening are those who will be working on the land when they grow up. These should certainly have the preference when selecting the pupils for the gardening class, as such training will, if rightly directed and understood, be a considerable help to them in years to come. It is a pity that each scholar in every school cannot have some practical training in such an important and helpful subject as
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gardening. Almost everyone in later years is interested in one part of gardening or another, and the remarks one hears passed about this plant or that crop show the stupendous ignorance of people whom one would expect to know better. But it is impossible to supply the land, &c., so that every scholar may get some practical training. However, if gardening is correlated with most of the other subjects, many of the other children may be frequently taken out into the school garden to watch the progress of the crops, noting any peculiar condition, such as the effects of drought, or of too much rain at certain times, the effects of frost, or what happens when the plants are attacked by insects or disease, &c.

Many subjects in school can be correlated with gardening, and when this is done the teaching of gardening is greatly improved, while the other subjects are what one might say “endowed with life”, they have a real meaning.

If we wish to correlate arithmetic with gardening we can put the young children to calculate the cost of manure, seeds, pea-sticks, labels, &c., or to estimate the prices of the various crops, and then as the children become older they may be given harder sums to do, such as finding the area of the garden and of the plots, paths, &c., or the amount of manure required to the pole or acre of both natural and artificial manures.

Bookkeeping should also be correlated with gardening. If one gives children the actual prices, and allows them to see what is being priced, they can then grasp more fully the principle of keeping books. If they sell their produce they know they ought to mark it down or they will forget what money they have taken for it, and they will understand why at the end of the year they should go over their accounts and see if they have spent more than they have received, when it would be a loss, or if they have received more than they have spent, when a gain would have been made. In these cases bookkeeping becomes quite simple; it will come naturally to the children, and they can grasp the principle of it in a way they could never do when using figures in relation to things of which they have little idea.

Reading can, and should, be correlated with gardening. The children can study the methods of cultivation of their various crops, and what good writers have written about the soils, manures, growth of plants, insect pests, diseases, &c. The reading lesson then becomes more interesting, because they are reading about something which they desire to understand. At first the children may, perhaps, think more of the subject than of the reading itself, but in reading it over again they begin to appreciate the style of
the sentences, &c., because they will understand the subject thoroughly. They are then doing two things at the same time, learning to read and learning gardening.

Gardening should be correlated with writing and composition. When the composition is chosen from some subject with which the children are familiar they will naturally put their thoughts down in regular order. For instance, they might be told to write an account of any piece of work which they had done in the garden, and such subjects are plentiful. If this were the rule, the children in the gardening class would pay better attention to their work in the garden, and then, given time to think it over in composition lesson, would be better able to put their observations into sentences and paragraphs. When one listens to the conversation of children it is seen that they can generally make themselves very well understood to each other on any subject which they really understand; therefore, when they have done any piece of work thoroughly in the garden they know all about it, and a composition lesson on it is a comparatively easy matter; and whatever tends to make a lesson easier is good for the child as well as for the teacher.

Few subjects lend themselves to correlation with gardening more readily than drawing. If the garden itself is laid out in a simple design, the whole may be measured by the children and drawn to scale. Then each individual plot may be measured and drawn to scale, and may afterwards be marked out for the crops it is proposed to grow on it, keeping strictly to the scale. This, of course, will also serve as a lesson on mensuration, as every part will have to fit in exactly. When the cropping plan has been properly prepared, the children should be able to work from it correctly at seed-sowing or planting-out time. Then, again, there is free-hand drawing; what more suitable subjects could one get than those which the garden produces, the leaves of various plants, a young plant itself, a flower, a fruit, &c. The children will naturally take greater pains in reproducing on paper an object which they have carefully watched over since it first peeped through the soil, or since the tiny brown scales burst in spring, liberating the beautiful foliage of the fruit, or other trees or bushes. If a boy or girl comes across anything abnormal in the garden it should be drawn, or if any of their plants are attacked by disease or insects they should draw them, thus keeping records of their work which will be a guide to them in future years. The work will always be better done when there is a sound reason for doing it.

Where woodwork is taught at school it may be most advantageously
correlated with gardening work. The seed and cutting boxes may be made by the boys; a garden frame with sash complete may also be made; the tools may be repaired; the tool shed may be repaired if required, new glass fitted in the windows, and the painting done. All this work is more or less rough in character, but it should teach the boys the proper method of using the various tools, and, if well done, will prepare them for the more advanced work which they will be called upon to do in the woodwork class.

Where bee and poultry keeping are carried on with gardening, the boys of the woodwork class may make the fowl houses, beehives, &c. Thus in many ways the boys in rural schools may be trained at school to take their part in rural work as well as the boys are trained now to take their places in offices, &c.

Geography can be most interestingly taught to children when we consider the plants which grow in the various countries, and the adaptability of such plants to their natural habitat. It becomes more interesting to the children when, in speaking of the very hot and arid countries, we tell them of some of the plants which grow there and how they are protected from the burning sun and the long-protracted drought. How that many of them have not leaves like our native plants, but have thick, fleshy stems which store up great quantities of food substances and moisture, on which they live when the dry season comes. Good examples of this are the cacti. Or, again, how many are covered with a thick coat of rough hairs to prevent the loss of the moisture stored up in the stems by the dry atmosphere drawing it out of the air pores. The palms of tropical countries have leaves, but those exposed to the sun are more or less hard, this being to protect the chlorophyll (or assimilating tissue) inside, otherwise the sun would destroy it. The small-growing plants of Alpine countries, which, when covered over with snow are safe until spring, with their large quantities of bright flowers produced in early summer, will tell us something of their hard life; they are covered with the frozen snow in winter, and as soon as spring returns they immediately produce their lovely little flowers while there is yet moisture in the soil, after which they are more or less dried up. Growing in the crevices of the rocks, &c., the moisture in the small quantities of soil in such places is soon taken up by the plant or given off in evaporation, therefore these plants produce their flowers and seed in the spring or early summer, while they have sufficient moisture. Again, we come to our own climate with our beautiful gardens, vegetables, fruits, and flowers, our beautiful green lawns, which are the envy of the world, allowing
many games to be played on them for a considerable period of each year, and some all the year round. Then farther north the plants met with are different in character, the leaves are smaller, such as the heaths, pines, &c., until the very hardiest of the pines only are able to withstand the rigours of the arctic winters. The leaves on such trees are small to allow the intensely cold winds to play through them without doing any damage. If the leaves of the trees of our climate were subjected to the same cold wind they would be torn to pieces by its force and shrivelled up by the cold. Hence we see how interesting the Geography lessons can be made to those children who know something of the cultivation of plants in the school garden.

The garden is an ideal place in which to teach Nature Study. Here the children can study Nature in nearly all its branches. The soil can be examined, thus finding out that it is made up of large and small stones—some very small—and tiny particles of sand, which, of course, are simply minute stones. The various actions may be watched whereby the larger stones are gradually acted upon by the acids in the soil and the weak acids given out by the plant roots, and dissolved, forming liquid plant food when it is taken up by the plant through the porous walls of the root hairs. But there are other substances in the soil which are plainly seen not to be of mineral origin, such as the decaying roots of plants, &c. These, again, when converted into liquid, are absorbed by the root hairs as another valuable part of the plant's food.

The plants may be carefully watched, how they grow from the germination of the seed through all the stages of their development to the production of seed again. Or the various forms of plant life may be studied from the lowest forms—the Bacteria, or single-celled plants, which inhabit the soil in almost countless numbers; the Algae, green cells or green threads which are formed on the trunks or branches of trees, bushes, &c., and on the damp surface of soil; the Fungi, which grow as white threads and flat soft outgrowths from decaying wood, or as the umbrella-shaped growth from the ground: mushrooms, toadstools, &c.—to the higher forms of plant life.

The Lichens, grey or yellowish, flat or fringed plants which grow on stones, tree trunks, &c.; the Mosses, which grow in fringed tufts almost everywhere, on walls, on tree trunks, or on the soil; the Liverworts, which grow in flat green patches on damp soils, &c.; the Ferns, which grow in shady places on the soil or sometimes on the trunks of moss-covered trees; the flowering plants, which are the highest form of plants, and to which
most of our cultivated garden plants belong; all may be studied in the garden.

Certain animals may also be studied, with their relations to each other and to the plants grown in the garden. The Amœbæ are some of the lowest forms of animal life and are found in the soil. They devour in great numbers the little beneficial Bacteria in the soil. The Earthworm is familiar to all, and does so much good in making burrows, allowing the water to pass away from heavy soils, and also in crushing the particles of soil which it swallows with its food, making it finer and more easily soluble for the use of plants. Earthworms, however, are not desirable in flower pots, as their burrows allow the water to pass too quickly and prevent the soil getting thoroughly moistened. The Millipede live more or less on decaying matter, but do harm, if in large numbers, to potatoes and plant roots. Some insects are very useful in pollinating the flowers, whilst others are very harmful in the larval stage, destroying the plants (as explained in chapter XV). The garden snails and slugs do much damage to our garden plants. The frogs and toads in the adult stage assist in keeping down, by devouring, numbers of the lower harmful forms of animals in the garden. Some birds are useful in so far that they feed on insects and other forms of the lower harmful animals, but some are harmful in eating parts of plants, fruit, &c. Mice and rats devour seeds and parts of plants. Rabbits devour the garden plants very quickly. Squirrels carry off large numbers of the various nuts grown in the gardens.

The weather or climatic conditions can be studied very interestingly with relation to the garden, and, where a meteorological station can be attached to the school garden, it is of exceptional educational value. The direction and velocity of the wind may be carefully noted, and also the action of sharp cold winds on plants, as well as hot, dry ones. The condition of the atmosphere as to heat; dry- and wet-bulb thermometers, maximum and minimum thermometers, may also be used. The pressure of the atmosphere, by the aid of the barometer, may also be noted. The clouds also may be watched and carefully noted; their forms: cumulus, large and fleecy; stratus, streaky; nimbus, when the sky is covered or rainy; &c. The sunshine at various seasons of the year, the shadows cast from objects, and their effect on plants, &c. The frosty atmosphere and the effect of frost on plants, &c., all may be taken in the garden. When all these things can be studied in relation to actual living things, and in relation to each other, as they can be in the school garden, they have real significance, and all become intensely interesting to the children.
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Where elementary science is taught, the school garden again is a great aid to its effective teaching. Geology can be made most interesting with regard to rock formation and decay, and the formation of soils. Chemistry is involved, with regard to the elements which are in combination to form the rocks and minerals, the food of plants, the composition of the atmosphere, the composition of the plant, &c., the manures to apply to soils, and the ingredients to use to destroy harmful insects, and the diseases which attack the plants. Botany can be studied with regard to the life and growth of the garden plants; the parts of the plant and the functions of each part. Meteorology is concerned with regard to the atmosphere and the climatic conditions, and their effects on plants in the garden, &c.

Thus it will be seen how useful the school garden may become, not only in giving those children who, in the future, will earn their livelihood on the land a thorough training for their work, but also in imparting a sound educational equipment to all scholars, whatever their future callings may be.
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