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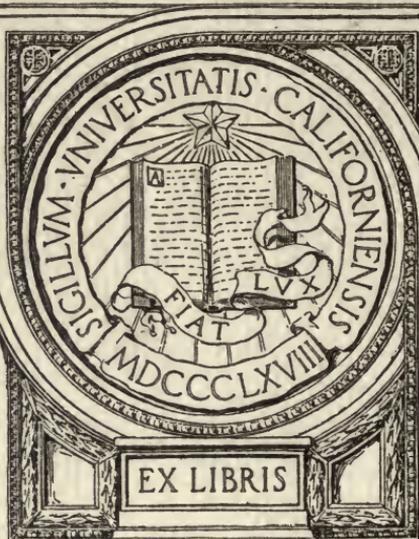
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FOUR ESSAYS

WRITTEN BY STUDENTS AT WISLEY, 1913

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ESSAYS SUBMITTED BY WISLEY STUDENTS

IN PART QUALIFICATION FOR THE DIPLOMA OF THE SCHOOL.

EXPLANATORY NOTE.

SOME few Fellows of the Society, and, I fear, a good many professional gardeners, are somewhat sceptical of the good work which the Society is doing at Wisley for the practical education of the Students. It is almost useless to refer such sceptics to the statistics of our Annual Examination at Wisley and point out how well the Students acquit themselves, because the reply is almost universally, "Oh, I don't believe in Examinations."

Now one item of this Annual Examination is that every Student has to write an Essay on any subject he likes connected with his work, and it occurred to me that if one or two of these Essays were published exactly in the form and word for word as they were sent in, without any correction whatsoever, it might serve to show the Fellows something of the result of our Wisley teaching and prove how useful and practical it is in its application.

I have therefore obtained the consent of the Council to the publication—not of one, for one might be considered as possibly quite exceptional, but—of four of these Essays written for this year's Examination (1913); and I have purposely chosen them on widely differing subjects, so as to show how wide and practical is the scope of our Wisley teaching.

I have requested Mr. Chittenden, the Director of the Wisley School, to be so kind as to put in footnote corrections of any noteworthy errors, so that these Essays may not mislead our Fellows in any way, or make them suppose that they are absolute perfection. The only other corrections are a few very slight grammatical emendations where the English seemed somewhat harsh. They are not *perfect*, but we consider them to be very highly creditable both to the Students themselves and to the whole Teaching Staff of the Society.

The order in which the Essays are printed is not that of merit, but alphabetical of the names of the Students.

W. WILKS,
Secretary, R.H.S.

ROSES AND THEIR CULTIVATION.

By ALEX. DICKSON.

IN this paper I propose to deal with roses and their cultivation, and as the space at my disposal is limited I can only deal briefly with the classification of the more important sections.

Within recent years the greatest gain of the rose has been the improvements effected through the creation of a new class, viz. *Hybrid Tea*, which has given us very many lovely roses, of such a free and continuous flowering character that we now have our gardens gay from May till November, and in the milder districts of Great Britain and Ireland it is not unusual to gather blooms of these more modern roses at Christmas.

BRIEF NOTE ON ORIGIN OF PRESENT-DAY SPECIES OR CLASSES.

Rosa damascena (*Damask Rose*).—This is a species of great antiquity. It is generally believed to have been introduced into England in 1573. For upwards of 200 years the rose underwent little or no change, but in subsequent years it was improved and varied to a great degree, the first step being the *Damask Perpetual*.

The origin of the "Hybrid Perpetual," or, as the French growers term it, "Hybrid Remontant," is various. The first recognized varieties were raised from crosses between those of the "Hybrid Bourbon" or "Hybrid China" and the "Damask Perpetual" in 1837, while later others were raised from crosses of varieties of *Rosa gallica* with the "Damask Perpetual." There is also to be found Noisette blood in some of the varieties described in this class.

The Origin of the Hybrid Bourbon.—This species has in greater part descended from crosses effected between varieties of the *French* or *Provence* with the *Bourbon*.

The China or Bengal Rose is closely related to the *Rosa indica*, and there can be little doubt but that several of the varieties of recent introduction are the product of crosses between varieties of the *China* and *Tea*, notably such beautiful and justly esteemed ones as 'Comtesse de Cayla,' 'Madame Eugène Resal,' 'Mrs. Edward Clayton,' and 'Queen Mab.'

The Hybrids of the Austrian Briars.—These resulted from a cross between the *Austrian Briar* (*Rosa lutea*) and the Hybrid Perpetual 'Antoine Ducher.' In this class we now have several very beautiful varieties possessing charming colours, shades or tints hitherto unknown. The most noteworthy are 'Lyon Rose,' a variety that varies in colour most considerably, especially on heavy soils, and 'Rayon d'Or,' a self-yellow of absolute distinctness, and 'Juliet,' which is a mingling of old gold, coppery red, and deep rose shades, a truly lovely combination.

Rosa multiflora is one of the ancestors of our climbing roses, and was introduced into England in 1804, from China or Japan. The 'Crimson Rambler' belongs to this group and has probably descended from the old *multiflora rubra*.

Rosa Wichuraiana.—This species is a native of Japan and at the present is being extensively hybridized, with the result that many beautiful varieties have been created, which are now much in evidence in all gardens where roses are cultivated, being grown as weeping standards or for covering pergolas, banks, &c.

Rosa centiflora (*Provence Rose*).—We have all heard of the "Old Provence," or, as it is more frequently called, the "Cabbage Rose." The *pink variety* was introduced in 1596, and the *white variety* in 1810. They both possess delightful fragrance and are of easy cultivation, making good bushes and flowering profusely in June. This class, with Moss Roses and Striped Provence, is classed under the *Gallica section*.

Rosa indica.—It is to this section that the Tea-scented Roses belong. It was in 1810 the *Blush Tea-scented* was introduced from China, and fourteen years later the *yellow variety* was received from the same country. From these two varieties have sprung a very large and popular family, many members of which possess a strong tea scent, hence their name. Within recent years the great advance that has been made in this class has been the production of varieties possessing greater hardiness and vigour, more capable of withstanding our winters. Some of the best of these are 'Maman Cochet' and its white sport, 'Mrs. Myles Kennedy,' 'Mrs. Foley Hobbs,' 'Harry Kirk,' 'Madame Jules Gravereaux,' 'Alex. Hill Gray,' and 'Lady Hillingdon.'

The *Hybrid Teas* are the outcome of crosses between varieties of the *Tea and Hybrid Perpetual* classes, and are largely a creation of the past three decades. This section at the present time is the most popular of all. They are much hardier than the Teas, and are much freer and more continuous in bloom than any other class. It is exceedingly difficult to say to which group some of these hybrids properly belong, as in some instances they might easily be classed as Teas and in others as Hybrid Perpetuals, but in the majority of cases they are quite distinct from both.

CULTIVATION.

Locality, Soil and its Treatment.—If it were within one's power to select a site best suited for the cultivation of roses, the choice should be made a good distance from any large town, so as to have the advantage of pure air. It should be open, yet sheltered, on ground slightly sloping to the S.S.E. or S.W., so as to get a maximum amount of morning sun; it should also be sufficiently far removed from trees that their roots cannot reach the soil of the rose beds, or the branches overshadow the beds so as to interfere with free circulation of air and light. The climate may be somewhat moist.

Occasionally it may occur that roses have to be grown under

conditions which are anything but favourable, such, for instance, as a town garden, where it is either difficult or impossible to improve on existing conditions; in such an event it will be necessary to select roses that are adaptable to such conditions. Often the more beautiful roses are those demanding the most favourable conditions for their proper development, consequently the growing of such under adverse conditions should not be attempted. Instead, the choice ought to be confined to the strongest-growing and robust varieties.

Soils.—It is rather a common idea that roses succeed best on a stiff, heavy clay soil; this is erroneous. If the soil could be chosen, a clayey loam containing 70 to 80 per cent. of clay is best for most varieties. A loamy soil containing 50 to 60 per cent. of clay is best for the more delicate roses which require warmth, such as Teas, Chinas, and some of the Hybrid Teas, also for such as are grown on their own roots. The soil can readily be made lighter previous to planting by the admixture of light turfy loam, leaf mould, or wood ashes.

With an open, airy, yet sheltered situation, and a clayey loam soil, roses can be grown to the greatest perfection.

Improvement of Soils.—When a piece of ground is secured we set about at once to try to improve it. In the case of roses, as in nearly everything else, the first thing to be seen to is *perfect drainage*. If drainage is not perfect it must be made so. Land is not in a fit condition unless the water can penetrate to a depth below that of the roots of the roses; we want the roots to go down, and stagnant water checks this descent, which means to the plant suffocation and starvation. We drain the land to save the plants from drowning in wet weather or from parching in dry weather. Perfect drainage may be secured by digging drains 3 feet 6 inches deep and about 10 yards apart (according to the nature of the ground), and laying drain tiles at the bottom with 6 inches of stones or brickbats placed over the tiles, the whole being covered with turfs laid with the grassy side down, the object being to keep the drain clear of soil. If drain tiles are not available, bushes, stones, brickbats, or clinkers, although not nearly so efficient, may be used. Secure a gentle slope from the higher ground.

When this is finished the ground should be trenched right through to the depth of about 3 feet, keeping the subsoil below and the good soil to the top. Leave the surface of the soil as rough as possible, so as to expose it to the fertilizing influences of the sun and air.

In the process of trenching a liberal supply of farmyard manure should be *mixed* with the soil to the depth of 10 to 15 inches. Cow manure is undoubtedly the best manure for roses, but if this cannot be obtained pig or horse will be found to be good substitutes.

The land is now ready for planting, but it should be left about one month longer if possible, to allow it to settle and to allow the sun and air to do their work. If the process of draining and trenching is done later than October it may be a good plan to defer planting until February, or as early in the spring as the soil is workable. In this case the ground should be forked or dug over again before planting,

and instead of adding the manure at the time of trenching, fork it in then.

Let us suppose the roses have been planted. I will now deal with the tilling of the surface. Tilling of the surface is of great importance. The process of stirring the surface opens the soil and renders it more capable of admitting air and water. Hoeing is the proper method of surface tillage after the trees have been planted. A fork should not be used if it can be helped, as it damages the fibrous roots near the surface and loosens the soil at the roots, a thing which the rose cannot bear. The object of hoeing is not so much to keep the weeds down as it is to stir, loosen, and pulverize the soil, and so check evaporation. Frequent hoeing is very necessary in summer, and I think I may say that is one of the reasons roses do so well at Wisley under adverse conditions. Where roses are planted in long rows the "Planet" hoe is very useful on account of the time saved, and the work is probably better done.

Roses are very gross feeders, and therefore a top dressing of farmyard manure, laid in the late winter or early spring, will be found very beneficial; it will also protect the plants from frost. The top dressing may be *lightly* forked in, in spring. This will apply especially to light soils.

Wet clay soils may be improved by the addition of either *quick* lime, burnt earth, or sharp sand. Lay on a good dressing of any of these and dig it in, mixing well with the existing soil, to the depth of about 12 inches. *Quick* lime will be found most beneficial. It should be used at the rate of about 12 ounces to the square yard. Burnt earth should always be at hand and used by everyone who cultivates roses on a wet adhesive soil.

For the improvement of peat soils a good dressing of lime, strong loam, or burnt earth may be added as advised before.

The worst soils for rose growing are those of a sandy or gravelly nature; on such they suffer exceedingly from drought, and consequently from various pests. The only plan in this case is to make up the beds. Clear out the soil to the depth of 20 inches, and fill up again with $\frac{2}{3}$ strong loam and $\frac{1}{3}$ decomposed farmyard manure.

Planting.—Before planting time one wants to think over what varieties are best suited for him. A good bedding rose should possess three *principal* qualities. It should be hardy, dwarf or moderately so, and free-flowering, giving a succession of flowers from early summer till late in autumn. Those who have not a good knowledge of varieties should visit the rose fields of some rose-grower and see them growing, and take advice from an expert.

On the arrival of plants in a bundle or hamper, they should be taken to a dry, cool shed, carefully unpacked and sprinkled all over with water, afterwards covering with a sack or mat. If they are not planted immediately they should be "heeled in," covering them about half-way up with soil. Roses should never be planted when the ground is in a wet or sodden condition, as firm planting is impossible. When the ground

is in a good condition the plants should be lifted, covered with a mat and taken to the bed where they are to be planted. If planted on a dry windy day it is a good plan to dip the roots in a thick puddle made from clay and water, which will protect them from the most severe winds.

When it is possible, roses should be given a bed to themselves in an open spot, and not planted among other flowers. A bed 3 feet wide will hold two rows of roses, and one 4 feet 6 inches will hold three rows. The distance between dwarf plants should be from 18 inches (according to the habit and vigour of the variety), for standards about 3 feet and for weeping standards a distance of 10 feet would be required. The beds having been made ready and the positions of the roses in them marked out, the next thing, and probably the most important of all, is to see that they are properly planted.

A hole should be dug about a foot square and of sufficient depth in the case of the dwarf to allow the junction of the stock and scion to be about one inch below the surface. In the case of a standard the hole should be 6 inches deep. A plant should now, and not till now, be taken from under the mat, sprinkled with water, and have its roots trimmed. Any damaged roots should be cut past the damaged part, and some of the longer roots may require to be tipped, cutting from the bottom upwards, so that the root can, when healed, go on down instead of growing up and then down.

A little bone meal may be mixed with the soil around the plant with advantage.

Now place the plant in the hole and spread out the roots horizontally and evenly in it, taking care that the roots do not cross each other. Some of the finest soil obtainable, mixed with burnt earth if any is at hand, should be sprinkled over the roots. Over this place 3 inches of soil and give the plant a slight pull upwards, so as to get the soil well round the roots; this should be trodden firm and the hole filled in, treading the soil very firmly round the plant. Firm planting is very necessary for the well-being of the rose.

The time of planting is worthy of consideration. The time for transplanting is, of course, in the resting season. The depth of inactivity in the case of the rose is from November to January. In selecting the time for planting our aim should be so to time the planting that the rose has as long a period as possible in which to establish itself before the growing season commences again.

This being so, the best time is the latter end of October and November, but may be safely continued until March. The condition of the soil as well as the plant must be considered. The temperature of the soil is higher in October and November than in February or March, and at these times the soil is drier and warmer than in midwinter. It is evident from this that autumn planting has the advantage. Some tender varieties of Tea-scented, China, and Noisettes, however, are as well left till spring before planting. Put such plants as these carefully away for the winter under a west wall. Roses of this kind often suffer severely from winter frosts; plant them in spring about April and they

have the growing season before them; they then get a firm hold of the ground by winter, and are better able to stand the severities of that season.

It cannot be too strongly impressed that planting should not take place unless the soil is sufficiently dry to be trodden firmly about the plant without it "caking."

A few words should have been said about roses planted singly on lawns. A hole should be dug 18 inches square and 18 inches deep, and the soil well enriched with farmyard manure; some $\frac{1}{4}$ -inch bone may also be added with advantage. The same would apply to rambling or other very vigorous roses, only the hole should be 2 feet cube. Do not allow grass to grow within 18 inches of the plant.

Too much care and attention to detail cannot be paid to this part of the work.

Pruning.—Pruning may be said to be the art of improving the productive power, the strength, and appearance of the plant. It consists of two operations: (1) The removal of dead, weak, overcrowded or otherwise useless shoots. Unripe wood (which in the spring will usually be found to have discoloured pith caused by the winter frosts) should be cut clean away to the base of the shoot. (2) Pruning proper, the shortening of those shoots which are allowed to remain after the thinning-out process has been completed.

In thinning out a shoot it should be either cut clean away to the base of the plant or to its starting point on the older shoot from which it arises. When pruning a shoot it should be cut to a dormant leaf-bud or "eye" (as it is called) pointing outwards. In order to keep a plant in a healthy and vigorous condition, some of the shoots which are more than two years old should each year be removed to make room for the young and more vigorous growths.

Roses need to be somewhat differently pruned according to the purpose for which they are grown. For instance, shoots must be cut back severely if the plant is required to produce exhibition blooms, but if for ordinary garden decoration the shoots must be left longer, if to form bushes they must be left still longer, and if to clothe pillars, arches, &c., some of the shoots will scarcely require shortening at all.

As a large range of varieties are available for different purposes, it is necessary in pruning to take into account the individual habits and requirements of each. This may be learned only by close observation.

It is impossible for me here to give an account of how every variety should be pruned, so I will just have to state the general rule, if indeed any rule can be laid down.

All roses, the first time after planting, should be severely pruned; they should be cut down to within 3 or 4 inches of the ground. Even in the case of strong-growing or climbing varieties, only the strongest shoots should be left more than a foot in length. Roses planted in autumn should be pruned the following spring, and if planted in spring should be pruned at the same time.

In pruning roses for ordinary garden decoration, the following rules may be laid down:—

1. All dead and unripe shoots must be cut clean away at the base whence they started.
2. In the shortening of shoots always cut to an eye pointing away from the centre of the plant.
3. Summer-flowering roses (those which bloom only once in the season) generally need thinning and training rather than hard cutting. The last year's shoots should be left fairly long, two-year-old shoots rather shorter, and three-year-old shoots shorter still.
4. After thinning out is completed, the remaining shoots should be cut back to 5-7 eyes. For exhibition the pruning should be the same, only more severe. Thin out more wood and cut back to 2-3 eyes. It may be necessary, probably about the end of May, as soon as the flower-buds can be seen, to remove with the fingers some of the surplus shoots, especially those which are "blind" (*i.e.* without flowering buds at the termination of the shoots), leaving only those which are most promising and best placed.

I have never had an opportunity of seeing any "cut backs" grown for exhibition, for roses for show are largely cut from maidens (*i.e.* plants which have been budded the previous summer). As a rule, larger specimen blooms are obtained from these, but of course in the case of a good many varieties "cut backs" produce better-formed flowers, and amateur exhibitors cannot discard their plants every year to make room for maidens.

Climbing or Rambling Roses.—These should have some of the older shoots cut away entirely each year, directly after the plants have flowered in early autumn, and the young shoots lightly tied in to take their place. Any shortening of the remaining shoots should be done in March of the following year. There are exceptions to this rule; some *Multifloras* which are crosses with the *Teas* and *Noisettes* flower best on the short laterals from the old wood, and consequently a good deal of this must be retained. Examples are found in 'Tea Rambler' and 'Aglaja.'

In the case of *Wichuraianas*, as the trusses of bloom spring from almost any part of the well-ripened stems of the previous year's growth, the pruning must be arranged to save as much as possible of the young strong growths and to cut out all the old wood which has not produced strong continuing laterals.

Roses which are weak growers require hard pruning, strong growing varieties require moderate pruning, and vigorous growers require light pruning.

Shoots which have a tendency to cross one another should be cut out, so that the plant may not become overcrowded. The centre should be kept open, so as to admit air and light.

Time of Pruning.—Dwarf and Standard Hybrid Perpetuals and Hybrid Teas should be pruned during the month of March,

starting first with the Hybrid Perpetuals, and going on to the Hybrid Teas.

Dwarf and Standard, Teas, Noisettes, and Chinas should be pruned during the month of April.

All climbing and rambling varieties should be thinned out as soon after flowering as possible, so as to allow the wood to ripen well and be pruned in March.

About the best advice that I can give for pruning ramblers and climbers is to follow very much the course which is observed in the cultivation of Raspberries, viz. to cut away the growths which have fruited and are exhausted—such would correspond with similar growths that have flowered for one or two years—and to reserve the best of the remaining growths.

Propagation.—The rose is capable of being propagated by seed, cuttings, budding, grafting, layers, and suckers.

The method of raising roses from seed is adopted mainly as a means of obtaining new varieties and I will therefore not attempt to deal with it; also for stocks, e.g. the seedling Briar.

Cuttings.—Cuttings may be made with varied success. The seasons which offer greatest advantages are late summer and autumn.

It is my opinion that most roses give much better results when budded on seedling or cutting Briar than when grown on their own roots. It is disastrous to propagate all roses from cuttings; many varieties may root, but the plants of the majority will be useless, as they are not possessed of sufficient vigour to grow on their own roots and flourish.

It is rather difficult to say which roses do well on their own roots, as this must be governed to a certain extent by the soil and climatic conditions. The only roses that I have found to yield good results from cuttings are the *Polyantha*, *Hybrid Sweet Briars*, a few of the *Chinas*, and one or two *Hybrid Perpetual*. A few *Wichuraianas* of the 'Dorothy Perkins' type, *Ayrshire* and *Boursault*, are also successfully struck from cuttings. Own-root roses, except in the varieties mentioned, are thoroughly unsatisfactory in this climate, which is too cold for plants so produced.

In this connexion, when roses are being replanted, if the junction of the bud and stock is cut deeply through the cambium, sufficient to create a callus, it will emit its own roots in addition to those of the stock, which may be a gain.

After the plants have flowered, select well-ripened shoots of moderate strength. Take the cutting with a heel if possible, being about 6 inches long, having about four eyes. Insert round the rim of a 48 pot and treat as hard-wooded cuttings. They should be ready for planting out the following autumn. Cuttings of those recommended for own-root cultivation may be planted in beds in the open ground in October, where they will root freely. A few boughs of some evergreen may be held in readiness to protect them from frost.

Before going on with budding, permit me first to say a few words

with regard to the very important point, namely *stocks and their propagation*.

The stocks mostly used are the dog rose (*Rosa canina*, seedling and cutting) and the Manetti. The former abounds in the hedges throughout Europe, and is (in this country) undoubtedly the best stock for almost all roses.

Cuttings of the dog rose may be taken at the end of October and inserted in beds, where they will root freely and be fit for planting out the following autumn. Nine months later, in July, the dog rose cuttings are in a fit condition for budding. So much for the cutting briar. The dog rose is also raised from seed, and is thought by some authorities to be superior to the cutting briar, especially on light soils, but when put to the test there is very little in it, beyond the fact that *as maidens* the seedling briar comes into flower ten days before the cuttings. The hips should be gathered in autumn, or when ripe, and mixed with sand and placed in a pit for twelve months. They must be turned over several times during the year. Sow in autumn or spring out of doors on a light soil; transplant into budding quarters when seedlings are about as thick as a straw. The seedlings are usually ready for budding six to nine months after sowing.

The *Manetti* is desirable for winter forcing under glass for such varieties as 'Richmond' and 'Killarney'; 'Sunburst' and other yellows being best on seedling briar, as the *Manetti*, being more excitable than the briar, starts much more quickly into growth. It is recommended by some authorities for hard varieties and the more vigorous-growing Hybrid Perpetuals, but I think investigation shows that this is not quite so, and only in the case of very few varieties would I recommend this, and then only for Scotland, North of England, and Ireland. The plants admittedly grow more vigorously the first year on the *Manetti*, but their subsequent decline is also more rapid. Probably the reason some nurserymen use the *Manetti* so much is because the buds take more readily and make larger plants the first year than on the dog rose.

The best stock for standard roses is the dog rose rooted up from the hedges in autumn. Before planting, the roots should be chopped off close to the stem with a small axe or some other such instrument and the tops shortened from 2 to 10 feet, according to the straightness and bulk of the stem. As the standard stocks shoot forth in spring they will sometimes produce buds right up the stem; all these should be removed except about three nearest the top; three placed triangularly are best. Two or three of these may be budded and cut away as soon as the eyes develop. Stocks of all kinds for dwarfs may be allowed to grow as they like till the time for budding arrives, then clean a sufficient space on the stem as low down as possible to allow the buds being inserted conveniently.

Budding is the chief and best way of propagating the rose, and is the method practised almost everywhere.

In the nursery fields, where the briars are planted in rows about

2 feet apart, the men work in batches of threes. After the fields have been well cleaned of weeds, the first man goes along the row and places a long piece of wood on top of the briars, treads on it, and so bends the briars away from him; he then scrapes the soil from around the plants till he comes to the roots, with a small three-pronged fork having the prongs at right angles to the fork.* He then cleans the "root stem" with a piece of cloth. The next man then starts; he is the budder proper. He brings his shoots containing the buds with him in a box of damp moss, taking them out as he needs them. The buds have been cut for him by some very experienced hand. The selecting of the buds from the plants is most important. To get the best results only well-ripened shoots that are carrying a flower bud, or such as a bloom has been recently cut from, should be selected. The shoots are cleaned before starting, taking off all the prickles and leaves, leaving only a small piece to the petiole.

A budding knife is the only tool necessary. Make a longitudinal cut, about an inch in length, as near the base of the plant as possible. The nearer you get to the base the less chance there is of suckers coming up. Some people bud on the young shoots of the briar and put two or three buds on the same plant; this of course has to be done in the case of standards, but is absolutely wrong where dwarfs are concerned; you get a better plant by budding low down, and suckers are reduced to a minimum. At the top of this longitudinal cut make a cross cut (T), taking care not to cut too deeply; through the bark is all that is necessary. Open the bark by inserting the handle of the knife in the cut. The stock is then ready to receive the bud. Cut the bud with half an inch of bark above and below it. Gently raise the bark on both sides and slip the bud in, pushing it by means of the petiole to the base of the incision. When this operation is finished the eye should be about the centre of the cut. If any of the bark projects at the top it should be cut off. This being finished, the third man comes along and binds in the bud, using raffia for the purpose. Commence tying in at the base of the cut, passing upwards until the whole cut is bound over; the operation is then completed. They require no further attention now until the end of January or February, when the wild plant is cut off close to the bud, and a stake put in to tie the young plant to as it grows. A plant thus treated will grow into a good plant, and flower in June of the following year.

The best time for budding is towards the end of June (if buds in good condition can be obtained), July, and August.

The time for the operation necessarily varies to some extent according to the season. You cannot, of course, bud until the stock is of sufficient size and the bark running freely; the wood from which the bud is taken must have time to ripen.

Grafting.—This method of propagation is used principally for roses under glass, but *Austrian Briars*, *Wichuraianas*, and most of the *Multifloras* are increased in this way.

* Fork-handle.—F. J. C.

Of all methods of propagation, grafting is the most expeditious ; plants grafted under glass in January will be in flower in three or four months' time. It is used chiefly by trade growers who desire to increase their stock of certain new varieties in the least possible time. The new roses sent out by the raiser in pots are cut into a number of small scions with one bud on each and grafted on to stocks in 60's, and within four months a stock of the plants is obtained.

In selecting stocks for grafting, whether they be Manetti or dog rose, they should be secured of various sizes ; the majority should be rather thicker than an ordinary pencil. It is well to pot the stocks into 60's a year previous to use. The best time for grafting roses under glass is from December to March. Nearly all species will succeed grafted, but the hard-wooded will succeed best. As it is necessary to have the stocks well in advance of the scion, the stocks should be placed in a bottom heat for about ten days before using, which will encourage the sap to run more freely.

The graft mostly used and with the best results is the whip graft. Cleft and wedge grafting are also employed.

The scions should be cut off from the plant as required, selecting well-ripened wood, cut into pieces an inch and a half in length ; one or two buds are sufficient to produce a strong plant. The stock should have the top cut off level about an inch from the base. Stock and scion should then be cut in an oblique direction, making as smooth and even a cut as possible and of the same length and slope, so that the bark of the scion may be on the bark of the stock. The cambiums (which are just under the bark) must meet on one side at least ; the more the cambiums come in contact the better the union. When the scion is placed in the right position it should be securely bound to the stock with raffia. Replace in bottom heat and keep the atmosphere somewhat moist.

Watch carefully for suckers which may come on badly prepared stocks ; they must be kept in check by cutting them out as they appear.

Shading the young and tender shoots and leaves from the sun will be found necessary. A cold strong current of air will also injure them greatly.

When the shoots are 3 or 4 inches long they should be removed to a cooler house or frame, and air admitted gradually to harden them off. Plants grafted in January will flower in May or June of the same year.

As I mentioned before, the Manetti stock is most often used for winter forcing under glass, especially by American growers, who force and grow roses for cut bloom by the thousand. I do not mean to say the Manetti is the only stock used for the purpose ; where such roses are grown on for a number of years I should certainly advise *Rosa canina* as the stock.

Layering.—This is a method of propagation not often resorted to in the case of the rose. To do this select some of the strongest shoots, stripping off the leaves half-way up the stem. Make a cut

upwards half-way through the stem for 2 inches in length and peg it down 2 or 3 inches deep, making the soil firm round it.

July and August are the best months for layering. If layered in July the free-rooters will be ready to take off in November. In spring they may be cut down to three or four eyes, and some may bloom the first summer or autumn after layering.

Suckers.—The Scotch Rose (*R. spinosissima*), *R. rugosa*, *R. alpina*, the Provence and Damask hybrids are given to throwing up suckers, but they are often difficult to separate from the mother plant with much root. Autumn is the best time to lift and replant suckers.

Enemies.—The chief enemies of the rose to be reckoned with are, Mildew, Black Spot, Rust, Grubs and Caterpillars, and Greenfly or Rose Aphis.

It should be borne in mind in all attempts to check diseases caused by fungi that "*Prevention is better than cure.*" The reason for this is the fact that the majority of fungus parasites, immediately after infection, spread in the living tissues of the plant they have attacked; hence it is impossible to kill the fungus without at the same time killing or at least severely injuring the plant. When a fungus spore falls on a leaf, germinates, and passes into the interior of the leaf, it commences to form spawn or mycelium, which grows at the expense of the material accumulated by the plant for its own use. This process of growth on the part of the spawn usually lasts for one or two weeks before the leaf shows any sign of the presence of the parasite.

When the spawn has accumulated a sufficient amount of reserve food, its presence is made known by a white or brown patch on the surface of the leaf, and later the fruit of the fungus bursts through to the surface, when the spores are quickly conveyed by wind, rain, insects, birds, &c., to neighbouring plants, and unless drastic measures are taken an epidemic is the result. From this it will be seen that infection has taken place before its presence is revealed under the familiar form of mildew or rust, and it is obvious that prevention is the point to be aimed at. To effect this two conditions are absolutely necessary, *cleanliness and spraying.*

Mildew.—This is undoubtedly the most destructive and at the same time the most prevalent disease with which the rose-grower has to contend. Generally speaking, "soft" foliage favours this disease, whereas hard wood cannot be so readily infected. This is not only true as regards foliage affected by weather conditions, but also as to the relative "hard" or "soft" foliage and shoots of different varieties of roses. A damp, warm, "muggy" season causes the foliage to remain soft and highly susceptible to disease; too strong doses of nitrogenous manure have the same effect. An exceptionally rainy season is unfavourable to the development of mildew and other fungus diseases, because the rain washes the spores to the ground almost as fast as they are produced.

Mildew, as a rule, first appears in the spring, soon after the foliage is full grown, and again, soon after midsummer, it attacks the leaves

and shoots of the new growth. The spring attack is usually mild and apt to be neglected, which may lead to serious results.

Preventive Measures.—In the case of mildew, infection is due to the winter spores that are produced on the white cottony mildew growing on the shoots. Cleanliness in this case therefore consists of carefully removing * every trace of the white felted substance from the shoots, stem and fruit, and burning it. This should be done as early in the season as possible, otherwise the winter spores will fall to the ground, where they will survive the winter and be a source of trouble next year.

The spawn of many kinds of parasitic fungi is perennial in the tissues of the plant attacked; in other words, when the plant is once infected the spawn remains in the living condition *in* the plant from year to year; this, however, is not so in the case of mildew or rose rust. During the winter a given rose tree, however seriously it may have been attacked by either or both of these diseases during the summer, is perfectly free from disease, and will remain so unless a *new* infection takes place.

Spraying.—It is important to note that spraying is purely preventive in its action. No disease can be killed by spraying. Spray with a solution of *potassium sulphide*, popularly known as “liver of sulphur,” 1 oz. in 3 gallons of rain water. This is an excellent fungicide against rose mildew. Later in the season, when the second attack comes on, a *slightly* stronger solution may be used to advantage. All bushes which have been attacked by any fungus should be thoroughly sprayed with a solution of *sulphate of copper*, 1 oz. in 2 gallons of water; the surrounding soil should be similarly treated. It is important to remember that this wash should be applied during mid-winter before the leaf buds begin to swell, otherwise the foliage will be destroyed.

The washes should be applied with as fine a spray as possible, and the spraying should commence at the first sign of mildew.

Rose Rust.—This fungus appears on the leaves and wood in the form of deep orange powdery patches. All leaves bearing winter spores should be collected and burnt. Winter spores do not form on the wood, but only on the leaves, which are covered with small black projecting points. If these are collected and burnt it will lessen the attack the following year considerably. Spray as advised for mildew. Two or three applications will be necessary. Take care that the solution gets at the inside of the bush. If the rust spores appear on the wood they may be treated with a solution of *methylated spirit and water*.

Black Spot.—This disease is confined to the foliage, and as a rule is in evidence before midsummer. It appears in the form of black spots almost circular in outline. This disease often does very considerable damage to rose trees. All diseased leaves should be removed and burnt. Commence spraying with *Bordeaux mixture* early in

* That is, by pruning away parts showing the fungus.—F. J. C.

spring and continue at intervals. Spraying will not be very effective if the disease is allowed to gain a foothold.

Insect Pests.—The rose beetle, the cockchafer, and the weevils are complained of as enemies of the rose.

The *beetles and cockchafers* eat the foliage and buds, and their grubs devour the roots. The grubs can only be got at by hand-picking. If grass turfs are placed upside down under the soil the grubs will collect in them, and they can be picked off and destroyed. Nothing but hand-picking can be resorted to for the beetles on the foliage and buds.

Weevils do harm by gnawing buds, foliage, and tender shoots. They can be caught by placing sacking on the ground; on the approach of light they fall from the tree and shelter there during the day, and so can be collected and destroyed. *Vaporite* will kill the larvæ in the soil.

Green Fly or Rose Aphis.—This is one of the very worst of rose pests. The lady-bird feeds on green fly, but in spite of this natural check the roses become covered with aphis. Spraying must be done with care or the tree will be injured. *Carbolic soft soap* and water is one of the best sprays, using about $\frac{1}{4}$ lb. to 5 gallons of water. To this may be added $\frac{1}{2}$ lb. of *quassia chips*.

Spray with *nicotine wash* for leaf-rolling *Sawfly*. The *Rose Slug-worm* may be destroyed with *nicotine or hellebore wash*.*

A large number of caterpillars and moths feed on the foliage of the rose. The best remedy is to spray with *arseniate of lead* early in the year.

VARIETIES.

Good roses for general garden cultivation.

- | | | |
|-----------------------------|--------|----------------------------------|
| 1. Dorothy Page Roberts | (H.T.) | Coppery pink. |
| 2. General McArthur | (H.T.) | Scarlet-crimson. |
| 3. Betty | (H.T.) | Coppery rose, shaded yellow. |
| 4. Gustav Grünerwald | (H.T.) | Carmine pink. |
| 5. Lady Ashtown | (H.T.) | Deep pink. |
| 6. Lady Pirrie | (H.T.) | Coppery salmon, shaded apricot. |
| 7. Mme. Jules Grolez | (H.T.) | Bright silvery rose. |
| 8. Mme. Ravary | (H.T.) | Pale orange-yellow, deep centre. |
| 9. Caroline Testout | (H.T.) | Satin rose. |
| 10. Mrs. Theodore Roosevelt | (H.T.) | Flesh tinged pink. |
| 11. Mme. Abel Chatenay | (H.T.) | Salmon-pink. |
| 12. Mabel Drew | (H.T.) | Canary-yellow. |

* To be successful with nicotine wash against these larvæ the spraying must be done while the pests are very young; otherwise lead arseniate should be used.—F. J. C.

GOOD BEDDING VARIETIES.

Dwarf :—Mme. Ravary, Mme. Jules Grolez, Comtesse du Cayla (H. China), G. C. Waud (orange-vermilion), Jessie (Poly. pom., bright rose crimson), and Liberty (crimson).

Medium :—Lady Ashtown, Mme. Abel Chatenay, Carine (orange-carmine to buff creamy salmon), Joseph Hill (coppery yellow-shaded salmon), Pharisäer (rosy white shaded salmon), Duchess of Wellington (orange-yellow).

Tall :—Frau Karl Druschki (H.P.), white; Irish Elegance, orange shaded apricot (H.T.); Hugh Dickson (H.P.), rich crimson; and La Tosca (H.T.), pink.

WEeping STANDARDS (*Wichuraiana*).

- | | |
|------------------------|-------------------------------|
| 1. Alberic Barbier | Creamy white, shaded yellow. |
| 2. Dorothy Perkins | Soft light pink. |
| 3. Dorothy Dennison | Shell pink. |
| 4. Excelsa | Bright scarlet. |
| 5. Hiawatha | Bright scarlet, light centre. |
| 6. Troubadour | Crimson. |
| 7. François Juranville | Deep salmon-pink. |
| 8. François Guillot | White tinged pink and cream. |

Pillars.—American Pillar (H. Poly.), deep pink, white eye; Gruss an Teplitz, Mme. Alfred Carrier, pure white, Ards Rover (H.P.), Lady Waterlow, Climbing Caroline Testout, Climbing Richmond or Liberty, and Conrad F. Meyer.

Exhibition.—Bessie Brown, Edward Mawley, Dean Hole, Lady Ashtown, Mildred Grant, Lyon Rose, Gloire de Chedane Guinoisseau, Hugh Dickson, Frau Karl Druschki, William Shean, George Dickson, Horace Vernet, Mrs. John Laing, Caroline Testout, Mme. Mélanie Soupert.

Pot Culture.—Melody, Mme. Abel Chatenay, Richmond, Sunburst, Mrs. Aaron Ward, Mrs. Geo. Sawyer, Molly Sharman Crawford, Killarney, Mrs. John Laing, Joseph Lowe, Alexander Hill Gray, Lady Hillingdon, Frau Karl Druschki and Ulrich Brunner.

Town Gardens.—Caroline Testout, Dr. O'Donel Brown, Gustav G. Grünerwald, La Tosca, Margaret Dickson, Mrs. John Laing.

Fragrant.—Horace Vernet, George Dickson, La France, Common Provence, Ulrich Brunner.

FERTILIZERS AND MANURES.

By D. E. NICHOLSON.

THOUGH aware that this subject is unlimited, and a large one to compress into a short essay, I thought, however, that it had an advantage, in affecting all branches of gardening. I propose to give a short description of the different values and advantages of the common fertilizers in use, both artificial and natural. Now it is only during the last century that the real use and value of manures have been found out. The original phrase "to manure" meant to cultivate the soil, thereby increasing its fertility, and this, of course, is the present object of using manures. The meaning then narrowed down to the application of lime, marl, or clay, and is now confined to the adding of substances which contain plant-food, such as farmyard manure and the ordinary chemical fertilizers. I should like to mention here that I have not dealt with any of the compounded horticultural manures, a good many of which are sold at excessive prices.

Fertility of the Soil.—Nearly all soils contain sufficient stores of plant-food to last several crops, but the fertility cannot be estimated by the amount of plant-food present alone, but also, and principally, by the amount in an available condition. Moreover, of the elements necessary to plant life, all except three are available in sufficient quantities for healthy growth, in most soils at least. These three are nitrogen, phosphates, and potash, the latter, however, being less often required than the other two. Thus, in order to get profitable returns, some fertilizer is very often required, which provides to the crop these three elements in an available form. Moreover, it is of little use to provide two out of the three, and leave out the third, if it is lacking.

Besides the improvement of the chemical composition of the soil, the mechanical condition must receive attention, and if the soil is very sandy or clayey it will probably require some form of humus to be added, in the former case to increase the water-content of the soil and hold it together, in the latter case to render it more porous and workable. Some form of lime is also necessary on some soils to help render the plant-food available, and on clayey soils to render them less sticky.

Absorption of Nutriment.—On analysing the component parts of a plant it is found that water constitutes most of the plant, the percentage, of course, varying greatly, the rest being made up of compounds of carbon with oxygen and hydrogen. Carbon constitutes about half the dry matter, and oxygen and hydrogen most of the remainder, together with a few other elements in small quantities.

The carbon is obtained from the air by the process of assimilation. From water-culture experiments (that is, by growing young plants with their roots in jars containing water with various known salts in known quantities), it has been found that nitrogen in compounds, phosphorus, sulphur, magnesium, calcium, and iron—all necessary constituents of a plant—must be taken in through the roots only. Though always present in the ash, sodium, silicon, and chlorine are not necessary. The experiments also show that no particles of food in a solid state can enter the plant's roots, but must first be dissolved either before application or in the soil water. Hence, the importance of having plenty of humus in the soil to retain the water. The salts in solution enter through the root-hairs, passing through the cell-wall into the cell-sap. If, however, the salt is in a stronger solution than the cell-sap, the reverse occurs, and the plant loses water and flags. Thus great care must be taken not to apply too strong a solution of any liquid manure to the active roots of plants. A similar result is seen in the scorching or burning of leaves, with which some too strong liquid manure has been in contact.

Nitrogenous Manures.—These are generally considered the most important, seeming to have a more distinct influence on an ordinary soil than any other fertilizer. Nearly all plants have to obtain their supply of nitrates from the soil, although there is such a large proportion of nitrogen in the air. Moreover, water-culture experiments show that exactly the same amount of nitrogen is removed by the plant when fully grown as was supplied to the water. Leguminous plants, however, such as beans, clover, and furze, are exceptions, and have the power of fixing the free nitrogen of the air. This they are enabled to perform by means of the nodules on their roots, the nodules being colonies of a certain bacterium, which provides the plant with nitrogenous matter from the air, and obtains from the plant in return the carbohydrates necessary for the fixation of nitrogen. The only limit to the quantity of nitrogen that can thus be supplied to the soil is the difficulty of cropping the ground with leguminous crops in frequent succession.

As regards the effect on a plant, nitrogenous manures serve to promote vegetative growth; in fact, the growth of a plant is almost proportionate to the amount supplied. Plants provided with an excess of nitrogen, however, mature late and show but little tendency to produce flowers or seed, and are moreover more susceptible of disease than normally manured ones.

Nitrate of soda and sulphate of ammonia are the two principal nitrogenous manures. The main sources of the former are the large deposits in Chile, and of the latter coal. As nitrate of soda is soluble in water, and easily washed down into the subsoil, it should be applied only as a top dressing during active growth, care being taken, of course, not to let it fall on the leaves, as it forms a strong solution with water and is liable to scorch them. This remark also applies to sulphate of ammonia. Nitrate of soda can be safely mixed with

any other fertilizer except sulphate of ammonia, superphosphate, and dissolved bones, the acid of these latter setting free the nitric acid in nitrate of soda, loss in value resulting. The bad effect of nitrate of soda on heavy clay soils is important. When applied to such soils it is found to increase their stickiness and destroy the tilth. The reason for this is a complicated one, and only the remedy can be mentioned here, this being to apply a mixture of nitrate of soda and sulphate of ammonia. This mixture must be put on at once, and not allowed to stand long, or the value will be impaired. The great advantage of nitrate of soda is its immediate availability when in the soil, and it is this that makes it so useful in early spring for stimulating a young crop when the weather is unfavourable. When purchasing, a guarantee of 95 per cent. purity should be obtained, this being the usual guarantee of the producer. It is sold in bags and should be carefully stored in a dry place, as it readily absorbs water. It usually contains $15\frac{1}{2}$ per cent. nitrogen, and is sold at about £12 a ton. A good top dressing for a young crop in active growth is 1 cwt. per acre, or 1 lb. to 40 square yards. Cabbages, celery, rhubarb, and others not grown for fruit or seed benefit by a dressing of 3-5 lb. to 40 square yards, provided that phosphates and potash are already present.

Sulphate is also soluble in water, and is grey in colour as a rule ; on being applied to the soil it is quickly absorbed. It should never be mixed with lime or basic slag, as a loss of free ammonia ensues if this is done. The continued use of sulphate of ammonia causes loss of lime to the soil, so a dressing of some form of lime should be given to soils deficient in it. As regards the respective merits of nitrate of soda and sulphate of ammonia, it is seen that the former has an advantage in inducing deep-rooting, so that plants suffer less in time of drought. Moreover, it suffers less from the inroads of bacterial pests, which cannot use it for food so easily as they can sulphate of ammonia.*

It is usually thought that the latter is better retained by the soil than nitrate of soda, and so is better in wet seasons, but before it can become available it has to be nitrified, and when in that condition is just as liable to be washed down as the other. However, on light soils, provided there is sufficient lime in the soil, sulphate of ammonia is to be preferred to nitrate of soda.

The price is from £15 to £16 a ton, and it contains about 20 per cent. nitrogen.

Two manures of recent introduction should be noted here, *calcium cyanamide* or nitrolim, and *nitrate of lime*. The first is obtained by combining calcium carbide with nitrogen. It is similar in its action to sulphate of ammonia, and is nearly as effective. As it is very light, and hangs in the air when sown, it is best to mix it with superphosphate, in the proportion of one of cyanamide to 5 to 10 of superphosphate, this making it quite easy to handle. As it is said to injure

* (?)—F. J. C.

germinating seeds owing to the ammonia it gives off, it should be mixed with the bare soil two or three weeks before the seed is sown. As a top dressing also it should be avoided. In one respect it is superior to sulphate of ammonia, which tends to render a soil acid if continually used, the lime in nitrolim preventing this. The lime in it also has a good effect on clayey soils, and thus has an advantage over nitrate of soda in this respect. It is sold as a fine dry black powder, containing from 17 to 20 per cent. nitrogen. As it absorbs water slowly, it can be stored easily if kept in a dry place. The price is about £20 to £24 a ton. Nitrate of lime is made by a process involving the combination of oxygen with nitrogen. It can be compared with nitrate of soda, and is of about the same value, having, moreover, the same advantages as nitrolim in containing lime which were mentioned above. Unlike the latter, it absorbs water readily, and is quick in its action, but is often difficult to spread, as when stored it soon cakes into lumps. It is said that this difficulty is overcome by mixing it with ashes. Superphosphate can also be used to mix it with, but in this case the mixture must be applied at once, owing to their bad effect on one another. Nitrate of lime is sold as a pale brown powder, containing on the average about 13 per cent. nitrogen. The price is about £25 a ton.*

Soot is another substance valuable as a nitrogenous manure, and has several good points. Being of a dark colour, it absorbs the sun's rays, and so raises the temperature of the soil. It also helps to lighten heavy soils, and so is much valued in clayey districts, besides keeping off slugs and snails, which dislike it very much. Soot is usually sold by the bushel of 28 lb. When applying, the soil should be dusted with it until quite black.

Shoddy and greaves consist of waste fragments of wool, silk, hair, skins, &c., from factories, and are valuable for the nitrogen they contain. Most animal products, such as hair, skin, fur, blood, &c., from slaughter-houses contain nitrogen and can be used as manure. All these, shoddy, animal products, &c., are insoluble in ordinary water, and very slow in their action, and so should be used for perennial occupants of the soil, such as vines, peaches, and other fruits, forming a source of slowly available nitrogen. They should be spread or dug in in early winter. The price of such manures varies according to their nitrogen content; 10 cwt. to 2 tons an acre, or 4 oz. to 1 lb. a square yard, should be applied, according to circumstances. Seaweed and waste fish, mussels, &c., are often used as manure near the coast, and are about as valuable as farmyard manure.

Phosphatic Manures.—Phosphates have a very different effect from nitrates on the plant. Whereas nitrogen promotes vegetative growth and retards fruiting, phosphates act as a stimulant for the production and early ripening of fruit and seed. The natural phosphates in the soil are insoluble in ordinary water, slow-acting, and difficult of access to the plant, so where quick returns are required some form of soluble phosphates should be used. Nearly all the

* This price is far above its actual value.—F. J. C.

phosphatic manures are compounds of phosphoric acid with lime. Only one, superphosphate, is freely soluble in water, and the value and price of phosphatic manures depend on the amount of soluble phosphates they contain.

Superphosphate was the first to be discovered. It is usually guaranteed to contain 26 per cent. soluble phosphate, and is sold at about £5 to £6 a ton. It is best to apply it early in the spring, and a dressing of 8 cwt. an acre, or 8 lb. to forty square yards is quite enough. Care must be taken in spreading it, as it burns the leaves if a large deposit falls on them. Superphosphate is especially valuable not only in helping the fruit to mature, but also in stimulating the root-action of young plants. It is the most effective of the phosphatic manures on most soils, except very sandy soils deficient in lime, and all acid soils. The presence of plenty of lime to ensure the precipitation of the soluble phosphoric acid should determine its choice. On most heavy clays *basic slag* is better, at about half the price of superphosphate, and is nearly as effective, when it is applied in early winter and has had time to saturate the soil water. Thus the choice between the two should be determined by the amount of lime in the soil, superphosphate being suitable for chalky and loamy soils, and basic slag for heavy soil, and soils deficient in lime, as it provides lime. For very light sandy soils a good mixture may be made as follows:—Two parts of superphosphate, with one of steamed bone flour or bone meal. Leave the heap for a time and break up thoroughly when caked. For sandy soils use “Super,” as basic slag is not much use on them.

Phosphate of potash is very soluble in water, and a valuable though costly fertilizer, the price being £40 a ton. A very effective liquid manure for such greenhouse plants as tomatos is made by dissolving $\frac{1}{4}$ to $\frac{1}{2}$ oz. of it to a gallon of water.

Phosphate of ammonia is also dear, but makes a good stimulant, $\frac{1}{2}$ to 1 oz. of it to one gallon of water being a satisfactory liquid manure for greenhouse purposes. The price is about £50 a ton.

Insoluble phosphates are very slow in action, as mentioned before, and should only be used when a reserve is needed for plants to draw upon gradually. *Steamed bone flour* is the best form, costing £10 to £12 a ton, and is very useful to mix in a fruit border under glass.

Bones and phosphatic guanos should be avoided, unless obtainable at very low prices.

Potassic Manures.—These are chiefly valuable on light sandy soils, especially for starch and sugar-producing crops, such as roots and fruits, and also for leguminous crops, peas, beans, &c. Moreover, fungoid diseases are less deadly to plants well supplied with potash than to those that are not. Plants benefit most in dry seasons from potassic manures, as they tend to delay maturity of the fruit until growth is completed. Wet clay soils do not seem to benefit by it much, as it increases their stickiness. In fact potassic fertilizers need

only be applied to light soils, to potash-loving plants, such as the potato and vine, as in most cases the action of nitrate of soda* sets free a sufficient quantity in the clayey soils.

Wood ashes were once the only source of potash ; now the saline deposits in Germany are the chief.

Kainit is the chief potassic fertilizer used in this country, containing about 12 per cent. potash. It should be applied in winter before growth starts, for the impurities in it to be washed away by rain ; it may be mixed with basic slag. These remarks apply to all potassic fertilizers, as well as the fact that some form of lime is necessary to help the soil hold them, or they will be washed away ; most soils, however, contain enough lime to effect this. *Kainit* is a crude product, *i.e.* unpurified ; *sylvanit* is another form, cheaper and about as effective. The price of *kainit* is about £6 a ton. Of the manufactured products *sulphate of potash* and *muriate of potash* are the chief. The latter is very injurious to active rootlets, and, as its price is high, sulphate should be preferred for ordinary purposes, although sometimes inferior in effect. The choice of crude or of manufactured potash salts depends on the soil and the time of application. If winter is the time, when rains can cleanse them, *kainit* or crude salts should be used. If, on the other hand, potash is needed on a heavy soil, especially near the time of the seed-sowing, manufactured or purified salts are preferable, producing, moreover, better quality crops, the price being about £16 a ton. As regards wood ashes, they can be applied with advantage, unless the potash has been washed out by rain. Coal ashes, on the other hand, should be avoided, except for heavy clay soils, which they help to lighten. They contain practically no plant-food.

Farmyard and Stable Manure.—This is very variable in quality. Horse and sheep manure are considered richer than cow and pig manure. On an average, in a ton of well-rotted farmyard manure there are about 10 lb. of nitrogen, 4 lb. of phosphates, and 10 lb. of potash. Perhaps its chief value is in improving the soil physically and in setting free plant-food already present, but unavailable. Soils rich in humus, which is provided by farmyard or stable manure, can better withstand drought than light soils, the former retaining water better than the latter. It also helps to make a clay soil more porous and workable. Many chemical changes take place, when once the heap is made up and left, involving loss both in weight and value. The nitrogenous materials are attacked by a certain bacterium, and part escapes into the air in the form of ammonia and carbonic acid gas. Other bacteria cause denitrification, entailing loss of nitrogen gas. After a time the strawy part of the manure is converted into humus, involving the loss of about a quarter of the original dry matter. The first two processes go on most rapidly in the earliest stages, gradually becoming slower and slower as time goes on, and it is then that the straw begins to change to humus. It will thus be seen that manure laid loosely

* Or lime.—F. J. C.

about on the ground would be subject to greater loss through evaporation than a firm, compact heap. Also, if in a loose condition, it will soon become dry, and assume a white, dusty appearance, due to the presence of the mycelium of fungi, and it may be taken for granted that the heap has lost in value considerably. Several preservatives have been tried to lower the loss of nitrogen from the heap, but all have been found too expensive, considering the small amount of nitrogen preserved. A good plan is to place a layer of old, well-rotted manure under the new heap. It must not be forgotten that there are one or two disadvantages in using farmyard manure, when choosing between this and artificial fertilizers. Besides the much larger bulk required for farmyard or stable manure, the elements composing it are but slowly available to the crop, especially the nitrogenous element, and a quick-acting fertilizer must be used if immediate effect is desired. On the other hand farmyard manure is a lasting manure, and is a continual source of gradually available plant-food. *Weeds* are frequently spread in farmyard manure, when seeds, and plants likely to root easily, such as couch grass, are thrown on the heap, and this practice is to be avoided.

As regards the application, if it is to be applied to bare ground, no time should be lost in transferring it from the heap to the soil, so that its loss in weight and value is as small as possible. If, however, it is to be applied to growing crops, especially plants with delicate roots, and germinating seeds, sufficient time must be allowed to let it rot, the fresh manure being injurious to such plants. Similarly the liquid manure, which is the most valuable part of the manure, is very apt to damage young rootlets, unless used judiciously. Foliage is also liable to be injured if the liquid manure is allowed to fall on it when watering.

As a rule, farmyard or stable manure should be applied in late autumn, to allow some time for it to decay and improve the texture of the soil. A mulch of manure is often very beneficial to both newly-planted and established plants, serving to prevent the roots drying up in hot, dry weather, and to keep out frost from the roots of such plants as *Roses* in winter. Care must be taken not to make the mulch too thick and wet, so as to keep the air from the roots, or they will be greatly injured.

The price of stable manure is about six or seven shillings a ton, and when not obtainable at that price some artificial fertilizers should be preferred.

For a light soil, cow manure is preferable, horse manure suiting a clay soil.

Guanos.—These resemble farmyard manure in the respect that they are complete fertilizers, but on the other hand they contribute only a small amount of humus to the soil. They contain, or should contain, large percentages of nitrogen and phosphates, together with a small amount of potash. The source of these *guanos* is the excreta from sea-birds, accumulated on a few groups of islands off the

coast of Peru. The best is obtained from the island of Chinchas, and contains about 16 per cent. nitrogen and 9 per cent. phosphoric acid, being light grey in colour when fresh. The guano sold in this country, however, contains about 5-8 per cent. nitrogen. Some kinds are much more phosphatic than others, and are browner in colour as a result. The large amount of phosphoric acid is due to the fish diet of the birds. The price is about £16 a ton.

The *cheaper grades* should be avoided, as uneconomic, being very slowly soluble, and therefore slowly available to the crop.

Besides the excreta of the birds, the guano contains also decayed remains of fish, birds, seaweeds, &c., together with a little sand.

Ichaboe guano is the only other commercial guano of any value. This comes from Ichaboe island, off the S.W. coast of Africa. It is generally inferior to that from Peru, and, though richer in nitrogen, contains proportionately less phosphoric acid and more sand. From these remarks it will be seen that a good guano possesses very great value as a fertilizer, affording a long and continual supply of food-material to the plant, but the heavy price £10 to £12 a ton, prohibits its extensive use where gardening is carried on for commercial purposes, it being economical to have slightly inferior crops with the use of far cheaper manures. However, where ordinary farmyard or stable manure is not to be obtained, Peruvian guano may be used with advantage, being in fact far cheaper than various compound chemical manures sold at excessive prices. Humus can be supplied by digging-in green crops and vegetable refuse. Care must be taken in applying it to the growing plant, or injury will result to the roots, and if mixed with potting soil the mixture must be left for a week before use.

Besides these true guanos, various materials obtained from fish refuse and meat refuse are used as manures. Fish guano is dried powdered fish refuse, most of the oil being first extracted. Meat guano is a similar product from meat refuse. These are also injurious to delicate rootlets, and should be applied in winter to the bare soil, at the rate of 2 to 10 cwt. an acre, or 1 to 4 oz. a square yard. Fish guano contains about 7 per cent. nitrogen, 14 per cent. phosphates, and 2 or 3 per cent. potash. Meat guano varies considerably in composition, averaging about 7 per cent. nitrogen and 35 to 40 per cent. phosphate of lime.

Poultry Manure.—This forms a valuable fertilizer, if to be had in sufficient quantities, being about four times as valuable as farmyard manure. It should be kept in a dry place. A good dressing is 1 or 2 lb. a square yard.

Pigeon Manure.—Although large quantities of this are difficult to obtain, it is well worth using as manure, being about eight times as valuable as farmyard manure. Apply at the rate of $\frac{1}{2}$ to $1\frac{1}{2}$ lb. a square yard.

Green Manures.—Mustard and vetches are the two commonest crops grown for this purpose. These are sown broadcast in late summer or autumn on ground just cleared of a crop, and are valuable in saving

the nitrates formed in the soil lying fallow. Weeds are smothered out by a thick crop like this, and humus is added to the soil when the crop is dug in and has rotted. Vetches, being a leguminous crop, add to the nitrogen in the soil, but unfortunately they have a drying effect on the soil, as they are not dug in till the following spring. On the other hand, mustard can be dug in in about eight weeks after sowing, and so takes much less water out of the soil, which is also open to winter rains. On the whole, for a light sandy soil mustard is the better crop, vetches being more suitable for a heavy soil.

Leaf-mould.—This, when thoroughly decayed, forms a valuable ingredient in potting soil. Good newly-fallen leaves from hardwood trees contain in one ton about 10–15 lb. nitrogen, 3 lb. phosphoric acid, and 6 lb. potash. Thus its chief value lies in contributing humus to the soil, and generally improving it mechanically, rather than in supplying much plant-food. Oak leaves make the best leaf-mould, beech leaves coming next. A stiff clay soil may be much improved by the addition of leaf-mould.

Peat.—There are two kinds of this material which are called peat. One, consisting of the decayed rhizomes and roots of bracken, is much used in the cultivation of orchids and ferns, and the more fibrous it is the better. The other kind, the real peat, consisting of decomposed plants, which are submerged for part of the year, and sand, is an acid soil, but is used as an ingredient in potting Azaleas, Heaths, Rhododendrons, &c.

Lime.—No proper manuring can be practised with good results unless a sufficient quantity of carbonate of lime is present in the soil. If less than .5–1 per cent. is found, an application is needed. A rough test for lime in the soil is to take a sample of soil and pour on it some hydrochloric acid. If the soil effervesces freely it may be considered to contain about 1 per cent.; if not, then lime is required. Both physical and chemical improvement in the soil is brought about by the addition of lime. On clay soils the former effect is most marked. The clay particles, which are very small, and stick together very fast when moistened, are cemented together into larger particles by the action of lime; thus the water is allowed to drain away, the soil becomes airier and drier, and consequently warms earlier in the spring, and less sticky, and so easier to work. Also it will not crack in dry weather, as the soil-water will be able to rise to the surface better.

Sandy soils are also benefited physically, the smaller particles being cemented together in a similar manner.

As regards the chemical action, lime prevents the soil from becoming acid. Acidity in the soil is brought about by the decay of vegetable matter, and when the soil is acid fungi flourish, and bacteria are hindered from carrying out the process of nitrification. Nitrogenous manures are not the only ones rendered more easily available by lime, both phosphatic and potassic manures requiring it. The action of lime on phosphatic manures is to increase their solubility, by forming

that sort of phosphate which is most quickly available. The effect on potassic manures is to bring the potash salts into solution, which otherwise would be precipitated and remain unavailable, if no lime were present.

Many fungoid and insect pests in the soil are destroyed by some forms of lime.

It should be mentioned here that the lime found in bones, superphosphate, gypsum, gas lime, &c., is not in a proper state to do away with liming the soil, as it is combined with acids in these manures.

The following are the commonest forms of lime :—

Quicklime, obtained by the burning of calcium carbonate, is the commonest kind. On combination with water it becomes slaked lime. If possible, always apply in the form of slaked lime ; if, however, quicklime has to be used, leave it in heaps, and when slaked by the rain it can be spread over the surface, as evenly as possible. It should not be allowed to become too wet and sticky, or it will be very difficult to handle. When it is in a suitable condition it falls into a fine powder. Applications are best made to the bare soil in autumn or winter, as, unless chalk is used, growing roots are greatly injured by lime. It should be applied at the rate of from 8 cwt. to 1 ton an acre, or 3-8 oz. a square yard. Chalk can be applied at the rate of 2-5 tons an acre, or 1-3 lb. a square yard, and should be hoed or forked in, being first broken up well.

It is better to apply oftener and in smaller quantities than seldom and in large quantities, as in the latter case a bad effect is produced by the delay of nitrification. The price of lime is about 9s. a ton.

Ground lime is quicklime ground up finely, but is less pure than the latter and costs about 18s. a ton.

Lime ashes are the waste product of the burning process, and are valuable if fairly clean, and free from clinkers.

Gas lime is obtained during the purification of coal gas over freshly slaked lime. It contains several impurities, including sulphur, and makes a very good insecticide if applied in late autumn to the bare soil, at the rate of about 1-2 tons an acre, or 8 oz.-1 lb. a square yard. However, any following crop for the next year would probably be a failure. The usual application is 5-10 cwt. an acre, or 2-4 oz. a square yard in winter. When old, it can be applied with safety to a growing crop. As mentioned before, this material has not an equal effect to that of quicklime, though clay soils are considerably improved by a dressing of it.*

Gypsum is crystallized sulphate of lime, and is chiefly valuable in setting free potash and stimulating leguminous crops. It has a preservative effect on ammonia, and is a cheap material to use. It should be applied in winter or early spring, at the rate of 3-4 oz. per square yard, or 8-10 cwt. per acre.

Salt is frequently used, but the value lies in liberating potash, not

* Owing to improvements in methods of purifying coal gas, gas lime has frequently little insecticidal or fungicidal properties at the present day.—F. J. C.

in supplying any plant-food. It is best to apply it with other manures, and is valuable for root-crops, and may even sometimes be used instead of potash manures. Like the latter, it has a bad effect on clay soils.

Eight-plot Test.—In order to ascertain accurately the effect of different manures on a particular soil, experiments with plots should be carried out, although the manures required can be roughly estimated by an analysis of the soil. As great accuracy as possible must be aimed at, as errors always creep in, however carefully the experiment is conducted, and unless the results show a difference of 10 per cent. in the yield of crop no accurate conclusions can be drawn. In choosing sites for the plots, uniformity in the nature and aspect of the soil must be strictly maintained, also in the size and shape of the plots, and the questions of previous manuring and cropping must be considered. A convenient size for the plots is about $\frac{1}{10}$ of an acre or more, and small plots of a few square yards are of little use in obtaining accurate conclusions, as the great care needed for the experiments on small plots counterbalances the effect of the manures on insect pests and fungi. The land must be measured out, and the manures weighed, and properly mixed and applied, about a week before sowing the seed. If possible, the plots should be laid out side by side, the number being eight in all. The choice among the fertilizers to be used should lie between (a) nitrate of soda and sulphate of ammonia, (b) superphosphate and basic slag, and (c) kainit and sulphate of potash, one of each being used, and the crop, of course, being the same on all the plots. On No. 1 plot apply nothing, on No. 2 nitrate of soda, on No. 3 superphosphate, on No. 4 kainit, on No. 5 both nitrate and superphosphate, on No. 6 both nitrate and kainit, on No. 7 both superphosphate and kainit, and on No. 8 all three. When the crop has been ascertained by weighing, comparisons can be made for the effects of using the different fertilizers singly and with other manures. Supplementary plots will show the best sort and best amount of any kind of fertilizer to be applied.

Purchase of Manures.—When buying artificial manures it is important to obtain from the seller a guaranteed analysis, showing the actual percentages of nitrogen, soluble phosphates, insoluble phosphates, and potash. The real worth of a manure may be determined by means of the unit system, and comparison may be made between the real value and the actual price. The unit value is the price of each 1 per cent. a ton of nitrogen, insoluble phosphates, soluble phosphates, and potash, as the case may be.

Taking sulphate of ammonia as a standard, the unit value of nitrogen is calculated at 10s. to 12s., varying with the price. Taking the price at £11 15s., and the percentage of nitrogen at 20 per cent., the unit value = £11 15s. divided by twenty, which is nearly 12s.

Thus, with 12s. as unit value of nitrogen, of soluble phosphates 4s., of insoluble phosphates 2s., and potash 4s., the real value of any manure offered can be calculated. Thus, supposing that a fertilizer was offered guaranteed to contain 9 per cent. nitrogen, 5 per cent.

soluble phosphate, 1 per cent. insoluble phosphates, and 2 per cent. potash, the real value would be 108s. for the nitrogen, 20s. for the soluble phosphates, 2s. for the insoluble phosphates, and 8s. for the potash, the total being £6 18s. a ton.

P.S.—The prices of the manures are very variable, and the figures given would probably have to be raised considerably as time goes on.

P.P.S.—As regards purchasing proprietary manures, it is often more economical to buy the separate ingredients, and mix them together, than to buy the advertised mixture; in this way also substances of no manurial value, such as sand, do not have to be paid for.

THE HARDY HERBACEOUS BORDER: ITS CONSTRUCTION AND THE CULTIVATION OF A FEW HARDY HERBACEOUS PERENNIALS.

By J. O. PRITCHARD.

IN the flower garden proper the hardy herbaceous border is usually, and undoubtedly should be, an important feature, and, being such, should therefore be apportioned a prominent position in it.

Some few years ago this important branch of horticulture suffered comparative neglect in consequence of a sudden popularity for ornamental carpet bedding, in which the chief aim seemed to be extreme formality, which point was always strictly observed. This popularity, however, proved to be to a great extent merely temporary, and as the result a reaction in favour of hardy herbaceous gardening may be said to have set in.

Notwithstanding the temporary set-back it received, at least as far as the commercial side of the question is concerned, there is scarcely any branch of gardening in which more progress has been made during the last twenty years or so than in the cultivation of hardy herbaceous perennials. In fact it may be said that the almost unlimited number of herbaceous perennials now available for hardy border cultivating renders the selection of desirable and suitable plants for almost any position a comparatively easy matter.

Whether the soil be heavy or light, chalky or peaty, swamp-like or elevated and fairly dry, plants in number and variety may be found which will, with ordinary care and attention, and the application of a little knowledge in selection and skill in planting, grow and flourish there.

Some borders thus considered always seem able to present a harmonious spectacle of tastefully arranged plants, in which the various colours, heights, and periods of flowering naturally appear to blend together.

In the construction of the border itself there are many necessary points to consider before satisfactory results can be gained. Of these, I think the first is to choose a desirable and suitable site.

To do this with any degree of satisfaction it is always advisable to consider the nature of the immediate locality, for there are some plants which do well and present a glorious picture of colour in one place, whilst in a situation may be only a few miles distant they prove to be utter failures, which no amount of care in cultivation seems able to remedy.

In all things there is an "ideal," and, in the case of a site for a border of this kind, one in full sun for as long as possible during the

to consider is "How to prepare the soil?" This is most important, and on whether it is done properly or not very often depends the success or failure of the border. To merely clear the ground of any refuse or vegetation which happens to be present, and which has probably already impoverished the soil, is to court failure or even disaster. Under such conditions, it is true, plants may "exist" for some time, but it is a certain fact that they will never be enabled to attain a flourishing condition.

For general purposes a loamy, well-drained soil will be found to produce the most satisfactory results. Where this condition is not already at hand steps must be taken to leaven the soil by the addition of long or short manure, leaf soil, peat or sand, as the nature of the soil demands, and in such quantities as seem desirable. If it is a very heavy soil or a clayey ground that has to be dealt with it should be set about in the autumn for preference, thoroughly drained, and trenched to a depth of at least 2 feet, and plenty of "long" stable manure and leaf-soil added and well worked in. Failing a supply of long manure, as is sometimes the case, long green vegetation, the tops of plants, will make an efficient substitute. After allowing the frost, &c., to help to break up the clayey lumps during winter, a good forking back in early spring will go a long way to finish making the ground in a good condition for planting. A light sandy soil, which, however, would probably not need such precautions as regards drainage, should also be thoroughly trenched and plenty of good "short" stable manure, leaf soil, and cow manure worked in, all these being beneficial in improving a light soil. Any soil, also, which is lacking in or deficient in lime should have a sufficient supply of this necessary factor added. This is usually necessary in a clay soil. In conclusion, on the point of ground preparation, it is essential to recognize that, in addition to providing a storehouse of food upon which the roots will draw, the necessity of furnishing adequate moisture is scarcely of less moment, and may even, under certain circumstances, become the primary factor upon which success or failure ultimately turns. Hence it follows that only deep digging, *i.e.* trenching, will attain this dual result, as the process of moving the soil not only aerates it, but tends also to liberate and produce elements readily available for the roots, while such a soil is more conservative of its moisture than one which is but shallowly dug.

Background and its Construction.—There are various ways in which a suitable background, as well as being effective, can be constructed for the border. Where the latter is made at the base of a wall or against a building, great care should be taken to avoid having the back portion of the border choked up with tall-growing vegetation with the idea of screening the bareness of the wall behind.

This desirable object can be obtained just as easily and with far greater effect by training over the face of the wall such plants as *Choisya*, *Clematis*, *Jasmine*, or *Forsythia suspensa*. If, however, a background of ornamental shrubs is to be constructed, it should be

done with an eye to after-effects, bearing in mind that variation in height is desirable, so as to avoid the necessity of having the same height of background behind a tall vigorously-growing plant, which in itself needs little or no background, as behind a much smaller and more slender-growing specimen.

There are many ornamental shrubs which will serve this purpose with excellent effect, but in the case of some of them which root rather too vigorously it will be found necessary to keep the border itself free from the encroachments of their roots, which would otherwise deprive other plants of the goodness of the soil, by periodically cutting them back. These roots are the great drawback to what is perhaps the best and most effective means of forming a background, *i.e.* one of hardy ornamental shrubs. Such subjects as Buddleias, Skimmias, and Berberis are all suitable, whilst the tallest Rambler Roses, or *Forsythia suspensa*, trained upon larch supports, are also plants which would aid in forming an attractive backing to a border.

Next comes the very important question of planting and all its details. In the case of hardy herbaceous perennials this operation may be carried out, I believe, any time during autumn, winter, or early spring, always provided, of course, that the ground is not in a frozen condition, nor the soil sticky from recent rain, as plants take more freely to the ground if the soil works freely at the time when they are put in. Another point worth consideration is to spread out the roots well when planting. This applies more especially to such subjects as the Hellebores, the young and brittle roots of which would be badly damaged if rammed in anyhow when planting.

Some authorities recommend that, when planting a border, it should be done with the idea of avoiding the necessity of digging over, or renovating the plants, for many years.

In general practice, however, it will undoubtedly be found better to lift the majority if not the whole of the plants at the end of three years at the latest, and re-dig and manure the ground thoroughly. Unless this is done, the stronger-growing plants encroach on their weaker and less vigorously growing neighbours, and may ultimately even kill them outright. To avoid this by cutting round the clumps with a spade is detrimental to the plants themselves, as it destroys all the younger and more healthy parts of the plant in favour of the older and more weakened.

Such plants, indeed, as *Lychnis*, *Monarda*, and *Achillea* are the better for being treated as annuals; by this I mean, it is better to lift the clumps every year and divide them, replanting only the youngest parts, which are in reality new plants. On the other hand, again, there are those which are best left undisturbed, as they are impatient of root disturbance and receive a severe check if interfered with. Some such as this are *Pæonies*, *Phloxes*, *Hellebores*, and *Dictamnus*. Another point to be avoided is having all the tallest plants at the back and the remainder sloping down to a foreground of the dwarfiest. This tends to give a rather painful air of symmetrical arrangement

to the border. It is of course very much a matter of personal taste how the planting should be carried out, but by arranging some of the tall plants at or near the front, or in the centre, and placing behind and beside these some of the dwarfer ones, according to whether they need plenty of sunshine or shade, a much more natural and better effect is gained. In fact, one of the objects in planting should be to make the plants themselves assist one another as much as possible. By this I mean, a tall plant can be readily utilized to shade a smaller one during the hottest part of the day, and in like manner a tender specimen can be protected from cold winds to a considerable extent if arranged next to one of a hardier and more robust constitution.

Staking.—In many cases this point is not attended to as it undoubtedly should be, for on the neatness and appropriateness with which the staking of the plants is carried out very often depend the satisfactory finishing touches which help to make the border complete. Nothing so much offends the eye as an unwieldy stake obtruding itself to one's notice in a position where a smaller and more slender one would be more suitable. The young shoots of some erect-growing plants must be necessarily provided with some support during their earlier period of growth, so as to prevent the stems becoming deformed or broken by the wind. This partial dislocation, occasioned by their being blown about by the wind, is sure to be completed or made worse if staking is left to a later date when the growths are well advanced and more set.

The massing and grouping of many of the plants are also to be considered. It is a common occurrence to find that one plant of a certain variety or species fails to excite any comment whatsoever. The individual appears commonplace. It may be because it is spare and straggling in growth or small and inconspicuous of flower. But it frequently happens, also, that what is ineffective as a single specimen becomes a beautiful and desirable subject for the border when grown as groups or in masses together. Primroses, Phloxes, and Asters when grown as single plants appear only very ordinary, but group a dozen or so of the same together and a much better effect is immediately gained.

Colour and Time of Flowering.—These points play a prominent part in the successful planting of a border, and, if studied properly in conjunction with each other, ensure the picturesque finish that is so desirable. The plants should be arranged so that the colours blend rather than clash with one another, and that the border may maintain its interest from one year's end to another. Harmony rather than contrast should be the rule in colour arrangement; and the breadth of any one colour in a mass or group should be large enough to have a certain charm without the danger of being wearisome. Where a definite plan of colouring is decided upon, it saves time and trouble if the plants, of which the flowers are approximately the same colour, but a little later than each other in appearance, are planted or grouped near together so as to keep the various parts of the border in continuous flower. For

example, Oriental poppies might well find a place next to some of the *Tritomas* (*Kniphofias*) of similar colour.

A progression of colour in a mixed border, for example, might begin with strong blues, light and dark, grouped with white and pale yellow, passing on to pink; then to rose colour, crimson, and the strongest scarlet, leading to orange and bright yellow. A paler yellow followed by white would distantly connect the warm colours with the lilacs and purples, and a colder white would combine them pleasantly with low-growing and cool-coloured leaves.

Warm colours are not difficult to place; scarlet, crimson, pink, orange, and yellow are easily arranged so as to pass agreeably from one to the other. Purple and lilac group well together, but are best kept well away from red and pink; they do well with the colder whites, but are seen at their best when surrounded or carpeted with grey-white foliage; but if it be desired to pass from a group of warm colour to purple and lilac, a good breadth of pale yellow or warm white may be interposed.

White is a colour needing consideration. Frequent repetition of white patches is not pleasant. It is generally found that one or two masses or groups of white-flowered plants are sufficient from one point of view in a border.

Blue is best approached by delicate contrasts of warm whites and pale yellows, such as *Oenothera Lamarckiana*, but rather avoiding the direct opposition of a strong blue and full yellow. In the sunniest places of the border warm colours are best prominent, as sunlight appears to aid in blending them together. The shady corners, on the other hand, seem best suited for the cooler and more delicate shades.

ARRANGEMENT (SEE PLAN, P. 30) AND CULTURAL NOTES ON A FEW HARDY HERBACEOUS PERENNIALS.

In the following, when rows are mentioned, it is only meaning roughly, so as to distinguish the positions of the various clumps or plants as relative to one another.

No border, of course, could look either natural or beautiful if the plants were arranged in set rows. The proposed border is 18 feet wide (and length of course as desired), thus allowing for at least six fairly large clumps, if desired, from back to front or vice versa.

The majority, if not all, of the plants are examples selected from Wisley Gardens.

As examples for the back row of the border the following would be suitable:

Aster var. 'Climax.'—A fine variety, not long introduced, with almost exceptionally large blossoms, blue in colour, and appearing from September onwards, attaining a height of 6 feet. Asters are usually propagated in spring by means of the growths that spring up round the old plant. These are inserted in a sandy compost in a cool frame, and soon root if kept shaded and sprinkled overhead.

Delphinium var. 'Imperial Mantle.'—With flowers dark blue in colour this variety often reaches a height of 7 feet. A succession of bloom in Delphiniums is obtained during June, July, and August, by continually cutting off the flowering spikes as soon as they are finished, and so preventing seed development. Every three or four years or so they should be divided and replanted, the best time to do it being in spring, just as growth commences, or in summer. If at the latter period, cut down the plants a week or ten days before division, till growth re-starts. Then carefully divide and replant, taking care to shade and water efficiently till they are established.

Verbascum olympicum.—One of the grandest of the Verbascums, 6 feet or more high, of sturdy growth, and having rich yellow flowers, which appear from May to August. The usual methods adopted for increasing this Verbascum, as well as others, are by seeds, sown about May, or by division of the rootstock.

Galega officinalis Hartlandi.—This is a native of Southern Europe and exhibits its pretty mauve and white flowers throughout the greater part of the summer. Reaching a height of 5 feet, it is most easily propagated by root division. If all dead flowers are kept pinched off, so that seed development is prevented, plants of this Galega frequently bloom again during autumn.

Aster 'Lil Fardell.'—A variety with rose-pink flowers, appearing at their best in late summer. The plant itself reaches a height of 5 or 6 feet, and is propagated as mentioned before for Asters.

Rudbeckia laciniata.—This is the tallest of the Rudbeckias, reaching anything from 7 to 10 feet in height and sometimes more. The leaves, as the name implies, are unevenly divided into narrow ribbons, or cut into larger lobes, different individuals varying much in leafage. Appearing early in August, the flower is large, 3 to 4 inches across, clear yellow in colour, having the rays curved downwards and a greenish conical disc. Plants live many years without spreading much, but are easily divided. Should the seed escape the attentions of the chaffinches and green linnets, self-sown seedlings come up round the plants quite easily.

Helianthus mollis.—Like the Michaelmas Daisies, the perennial Helianthus could ill be spared from the autumn garden. This particular one is no exception, and, growing up to 6 feet in height, exhibits its golden-yellow flowers from July to October. The usual method of propagating *H. mollis* is by division in autumn or spring.

Lupinus arboreus.—A valuable plant for dry soils and rocky banks, but also worth its place on the border. Its purplish variety is good, and there are some inferior "yellowish" varieties, but the best of all is the real yellow one, because whilst there are good blue perennial lupines there is no other good yellow. It forms a roundish bush 2 to 4 feet high, and is easily raised from seeds; handsome forms are usually increased by cuttings. It may be killed in severe winters, but is worth raising from time to time if this happens, where the soil suits it.

Eremurus robustus.—One of the best-known Eremuri in gardens, with a huge flower stem 6 to 10 feet high and crowned with a dense raceme of peach-coloured flowers nearly 2 inches across. A native of Turkestan, it is often seen forcing its shoots through frozen ground. Flowering in June, and given a suitable season in which to ripen its seeds, it can be propagated from seeds fairly easily.

Delphinium 'King of the Delphiniums.'—This is the last, but not the least important, example for the back row. One of the choicest of the numerous varieties now obtainable, it has large flower spikes of an intense indigo blue, the plant altogether reaching a height of 5 feet.

Examples for the second row, and starting to plant at the same end as before, as follows, firstly :

Thalictrum glaucum.—A native of the South of Europe, growing from 5 to 6 feet high, with grey-green finely cut leaves and feathery heads of pale yellow flowers, in June and July. The usual method of propagation is by division in autumn and spring.

Senecio Clivorum is a fairly new border plant from China, with large heart-shaped leaves a foot or more across, and of a shiny green colour. The tall, much-branched heads of orange and yellow flowers, with a brown centre 2 or 3 inches across, appear in July and August. Easy of culture, and raised from seed, it is not particular as to the soil in which it finds itself.

Campanula lactiflora coerulea.—A vigorous Caucasian species, 2 to 6 feet high. Flowering from July to September, it bears its blue flowers in loose panicles, and can be raised from seed in a cold frame in autumn or spring.

Delphinium 'Lizzie Van Veen.'—A splendid variety with azure-blue flowers, with a small white eye. It grows to a height of at least 5 feet and is propagated as mentioned before.

Verbascum 'Miss Willmott.'—Appearing from June onwards the flowers of this Verbascum are white in colour, the plant attaining a height of 6 feet. Propagated by seeds, and division if the plant should prove perennial.

Helenium grandicephalum striatum or as it is also called *H. nudiflorum*, a fine Texan perennial, 4 to 5 feet high, with lance-shaped leaves and heads of deep orange flowers about 2 inches across, having the ray florets striped and blotched with crimson. Heleniums grow in any garden soil and are somewhat coarse of growth. They may be increased by seeds sown in spring in cold frames, or more easily still by dividing the roots, preferably in spring.

Poterium canadense, which, although it attains a height of 6 feet, would not crowd out the plants behind it. It has deeply cut grey-green foliage, and long spikes of creamy white flowers from the tip of every shoot during late summer and early autumn. Where the room can be afforded several plants should be grouped together to gain the best effect. Propagation is by dividing the root stock in autumn.

Solidago Shortii, probably the best of the so-called Golden Rods, with spreading, finely arched heads of yellow blossoms appearing from August and onwards.

As they are coarse feeders and soon impoverish a rich soil, a top dressing of good manure every autumn and winter will enable the plants to be grown longer than usual without removal to renew the soil. They are best increased by division in early autumn or spring.

Veratrum nigrum.—An ornamental native of Central Europe, with erect stems 2 to 4 feet high, slightly bulbous at the base. The blackish-purple flowers, with oblong blunt segments, are borne in June in dense racemes 1 to 3 feet long. Veratrum prefers a rich, loamy soil, with a little peat and leaf mould present; the plants may be increased by separating the tufts about September or October, and this method is preferable to seed raising, as they germinate very irregularly and slowly, and very often not until the second year.

Aster ruber.—A variety growing about 6 feet high, and bearing masses of bright pink flowers in August and September. The last example for this row is

Rudbeckia angustifolia.—A native of wet places from New Jersey and Kentucky to Florida and Texas, 2 to 5 feet high, with slender stems and narrow glossy leaves. The flowers, during September and October, are of an orange-yellow colour, with a blackish-purple centre. As the seed rarely ripens, division during autumn or spring is resorted to for increasing stock, and the plants prefer plenty of space in which to develop to the best advantage.

Now comes the third row from the back, and with the next forms the centre of the border. As examples, the following:—

Asphodelus luteus.—Synonymous with *Asphodeline lutea*. It is a native of Southern Europe, 3 to 4 feet high, its erect-growing stems being covered with deep green, awl-shaped three-sided furrowed leaves, with distinct paler leaves. The pretty sweet-scented yellow flowers are borne in summer in a long dense raceme, each blossom springing from the axil of a buff-coloured bract. They flourish in ordinary garden soil, and are increased by root division in early Spring.

Sidalcea spicata rosea.—This plant has flowers of a rosy-pink colour and reaches a height of about 5 feet. Where the plants are not killed by winter frosts, division in early autumn or spring is the usual method of propagation, but seedling plants are usually more satisfactory.

Rudbeckia laciniata flore pleno.—The double-flowered form of the *R. laciniata* mentioned previously, but does not grow quite so tall. It is treated and propagated in a similar fashion.

Senecio Veitchianus, which is 5 feet in height, bears its yellow flowers during August and September. It is easily and generally increased by division, but this one also comes true when raised from seed.

Thalictrum dipterocarpum.—One of the prettiest of the Thalictrums, 3 feet in height, with rosy-pink flowers appearing in June and onwards, the petals offering a charming contrast to its citron-yellow anthers. It is readily propagated in early spring either by seeds or root division.

Delphinium Belladonna superba.—Truly a superb variety, with flowers of a beautiful blue. Propagated as before, by cuttings and division.

Aster 'Moonlight.'—This is probably still a little-known variety, being one of the latest and at the same time easily one of the best. If anything, finer than 'Climax,' it has flowers blue in colour, and to be seen at their best during the latter part of summer.

Doronicum 'Harpur Crewe,' also called *Doronicum plantagineum* var. *excelsum*, generally acknowledged to be easily the best of its kind. It grows about 5 feet high, with broadly heart-shaped, coarsely toothed leaves, and yellow daisy-like flowers 3 to 4 inches across, and blooms in spring and early summer. They are easily increased by division in early autumn, or immediately after flowering is over.

Aconitum Wilsonii.—This variety has rapidly attained a foremost position among the late-flowering perennials. A recent introduction from China, it is a strong erect grower, attaining a height of 5 or 6 feet, whilst its flower spikes, of massive build, are crowded with large hooded flowers of a rich medium blue. The centre spike, as with Delphiniums, opens first, during September, and the succession is maintained as the laterals flower during October. It is increased by division.

Anchusa italica, Dropmore variety.—About the same height as the last-mentioned plant, it also has blue flowers, which are borne on paniced racemes during summer. It is one of the best of the Anchusas and can be increased both by seeds and by division in early autumn or spring.

Rudbeckia 'Autumn Glow.'—A large golden-yellow flowered variety, reaching a height of as much as 6 or 7 feet, and flowering from August onwards. The plants last many years, but are better for an annual division of the rootstock.

Galega carnea plena.—This plant grows about 4 feet in height and bears deep pink flowers. It is advisable to divide this, as well as other Galegas, every third or fourth year in the border and give them fresh soil, although, given a rich loamy soil, they will bloom year after year. They are propagated by dividing the rootstock in early autumn or spring, the latter season being perhaps better on the whole. Cuttings of the non-flowering shoots may be inserted in cold frames during the summer months and kept close for a time.

Acanthus mollis.—A vigorous Italian perennial, 3 to 4 feet high, with large heart-shaped, lobed and toothed leaves. The flowers, appearing about June, July, and August, are white, rose, or lilac in colour, in the axils of deeply-toothed bracts and borne on spikes about 18 inches long, thrown well above the foliage.

They may be increased by dividing the roots in autumn or spring, and also by seeds sown in gentle heat about March. Cuttings of the roots are also resorted to for the purpose of increasing the stock.

Then comes the next or fourth row from the back, composed of such plants as below :—

Eryngium Wrightii.—One of the finest of the sea-hollies, attaining a height of 5 to 6 feet, and bearing its dark blue flowers from July onwards. They thrive in a light, well-drained sandy soil, and may be increased by very careful division early in autumn or spring. The better way of propagation, however, is to raise them from seed, sown as soon as ripe and kept in a cold frame till spring, when they will germinate successfully.

Artemisia gnaphaloides.—Although attaining a height of $3\frac{1}{2}$ feet, the chief beauty of this plant lies not in the white flowers but in the silvery-white foliage which it bears. This is the case with practically all Artemisias, and the plants thrive in the driest of soils, once they are established. *A. gnaphaloides* is readily increased either by division or cuttings.

Phlox 'Evelyn.'—A truly beautiful variety, 4 feet in height, with salmon-pink flowers.

Herbaceous Phloxes are now so popular and widely grown that it is scarcely necessary to say anything further about these deservedly popular plants. All Phloxes dislike a wet subsoil, and flourish best in a rich, well-manured loam. The cuttings of the stem and roots and division of the rootstock are the methods used for propagation. Unfortunately, varieties do not come true to seed, so that this method is resorted to only when new seedling varieties are desired. The first way is probably the best, as it is possible to strike them at practically all seasons.

Eupatorium ageratoides.—Although perhaps considered by many more suited to a wild garden than here, it nevertheless is desirable on a border if only on account of the profusion of bloom it bears.

From 3 to 5 feet high, it bears its white flowers in dense flat heads during August and September.

Growing in practically any soil, it is increased by dividing the rootstock in spring or early autumn, or by seeds sown in gentle bottom heat about March.

Monarda didyma.—A robust-growing plant, about 3 feet high, with head-like whorls of bright scarlet flowers, borne from July to September. It is increased by dividing the tufts or roots in autumn if growing in a light, rich soil, and in spring if on a heavy and somewhat moist soil. All Monardas will flourish in ordinary garden soil, in any position except that of deep shade.

Veronica orchidea.—This is a rather uncommon Speedwell but quite worth a place on the border. Growing to about 3 feet in height, it bears pretty blue flowers, which appear during August. The

easiest and most usual method of increasing this plant is by division of the rootstock soon after flowering.

Lupinus polyphyllus roseus is one of the handsomest of hardy herbaceous perennials. In height it varies from 3 to 6 feet, bearing tall flower spikes crowded with rosy-pink blossoms. Thriving in open positions in any kind of garden soil, it is also a fine subject for naturalizing, as it is able to hold its own against the stoutest weeds. It is mostly propagated by root division.

Kniphofia aloides.—This is probably the oldest of the Kniphofias, and certainly one of the very best of its family. It is the Flame Flower of the cottager's garden, and one of the most brilliant of the Lilyworts; an excellent border plant, it is suitable for all soils. Beginning to flower in late summer, it continues many weeks in perfection, whilst nearly 70 per cent. of the garden varieties are traceable to it. Propagation by division, and by offshoots obtained by cutting off the flowering stems.

Bocconia cordata, or Plume Poppy.—It is a handsome and vigorous perennial of the Poppy order, growing in erect tufts from 5 to 8 feet high, with numerous flowers in very large fawn-coloured panicles, appearing from June onwards. It should be grown in a deep rich loam, and long after the flowers have passed, the flat, pale brown seed pods look handsome. It may be increased by dividing the thickish roots in autumn or spring, or by cuttings in the form of suckers which spring up round the base.

Lychnis chalconica.—An old border plant, $1\frac{1}{2}$ to 4 feet in height, with large dense heads of brilliant scarlet flowers, and of easy culture in any good ordinary soil. (There is also a handsome double scarlet variety.) The single variety can be increased by seeds and also by division of the rootstock, in early autumn before the end of September, or in mild weather in spring.

Coreopsis grandiflora.—This fully deserves its second name, as its flowers are much larger than any other garden-grown Coreopsis. Its handsome flowers are borne on strong stems 12 to 18 inches long, brilliant and long lasting. Easy of cultivation, the seeds may be sown any time in spring and strong plants obtained ready to put into their flowering quarters by the following autumn. It can also be propagated by root division.

Incarvillea Olgae.—A handsome perennial, hardy in all but cold districts. Its pretty cut leaves are borne upon long straggling stems, which rather spoil its beauty. The tubular flowers, about 1 inch long and wide, are of a pretty pale pink, borne in loose clusters upon very short stalks during summer. The plant itself attains a height of about 3 feet. Large plants can be readily divided during early autumn, if care is taken to avoid injuring the fleshy roots it bears. Seeds sown in September will produce, by the following spring, plants to flower in the summer following sowing.

Next comes the second row from the front, and there is such a varied collection to select from, and all of suitable height, that it is no easy matter to decide which to take as examples.

Centranthus Sibthorpii.—A pretty Valerian, 3 feet in height, and bearing pink flowers during June and July. The perennial kinds of *Centranthus* may be increased by dividing the roots in early autumn or in spring; by cuttings of the young growths or side-shoots in spring or autumn under handlights; and some also from seeds best sown in autumn.

Gypsophila paniculata plena.—A beautiful perennial forming a dense, compact bush 2 to 3 feet high, which becomes covered with small white blossoms during summer. Although this species can be increased by dividing the thickish roots in spring, it is as a rule better to raise the plants from seeds, sown thinly out of doors during April and May, in a warm and not too sunny border in finely prepared soil. By the end of September, after having been thinned out beforehand, the young plants can be moved to their flowering quarters in the border.

Erigeron speciosus superbus.—A showy North American perennial about 2 feet high, and will grow in practically any soil. It has a large and fine flower, of a violet purple colour with an orange-coloured centre, which appears during June and July, and often later. It is easily raised by division in spring or early autumn, and, to obtain the best effect, should be planted in bold masses where possible.

Astilbe Davidii.—A recently introduced and handsome addition to our hardy perennials, about 4 or 5 feet high, with crimson-purple flowers borne about July. Division of the roots is the best way of propagation.

Campanula lactiflora.—The white form would suit here. It is a vigorous Caucasian species, 2 to 6 feet high, flowering from July to September and bearing its flowers in a loose panicle. Either seed or division is had recourse to for propagation, and an occasional division is necessary, as it quickly spreads.

Gypsophila Rokejeka.—Growing from anything up to 5 feet this bears freely of white flowers from September to the end of October. Propagation as mentioned before for *Gypsophilas*.

Senecio pulcher.—One of the handsomest of perennial *Senecios*, 2 to 3 feet high, bearing in late autumn rosy-purple flowers 2 to 3 inches across. It is hardy, but its beauty is often marred by frost and bad weather. It rarely ripens seeds, but it is easily increased in spring by cuttings of the roots, 1 inch long, pricked into pans of light sandy soil and placed on a greenhouse shelf.

The plants in the border should be afforded a little protection, if possible, from frost, on account of their late flowering period.

Betonica grandiflora.—A downy perennial, 1 to 2 feet high, native of Caucasus and Siberia, with beautiful reddish-purple flowers borne in many-flowered whorls in June and July, produced well above the foliage. It is useful in sunny situations and easily increased and renovated by dividing the crowns every second or third year in autumn or spring.

Aquilegia chrysantha.—This tall and beautiful species endures as a perennial where the other species perish, even on the stiff clays of North London. It comes true from seed, which is most safely

raised under glass, and the plant reaches a height of from 2 to 4 feet.

Eryngium Spinalba, which has prominent silvery-blue flower-heads, usually at their best during July. Growing to a height of about 5 feet, it is easily propagated by seeds and root-cuttings.

Delphinium Brunonianum.—A fairly rare species, native of Tibet. It is from 1 to 1½ foot high, and has light blue flowers with purple margins and black centres, in June and July. It is easily increased by seeds, division, or cuttings.

Veronica virginica alba.—A North American species, 3 or 4 feet high, bearing white flowers during July in spikes 6 to 10 inches long, usually with several shorter ones from the axils. This species likes a rather rich, light soil, and is increased fairly easily by division or seeds.

The question, now, of selecting examples of plants for the front row probably needs most consideration, but the following are fairly typical:—

Statice latifolia.—Usually considered the finest of all the Statices, it has wide-spreading flowering stems, bearing small purplish-blue flowers, appearing about June. This species is best increased by means of root cuttings. The plants should be lifted, certainly not later than the end of October and sooner if possible, and the healthy-looking roots cut into pieces about 2 inches long, with an oblique cut at the lower and a straight one at the upper end. Insert the cuttings perpendicularly in a cold frame, and quite 90 per cent. may be relied upon to produce plants by spring. Although also increased from seed, the seedlings are prone to vary and deteriorate.

Lychnis viscaria splendens plena.—This grows about 1½ foot high, with double rosy-red flowers, appearing about June, and is usually propagated by seed and division.

Veronica spicata alba.—A desirable native species, 6 to 18 inches high, with white spikes of flowers in June, July, and August. It is increased by division (and seeds?).

Nepeta Mussini.—This is an old border plant and considered by many as not now worth a place in any border. It has, however, pretty pale blue flowers in May, and continuing till September in blossom. Its height is 1½ foot, and it is usually increased by division of the root-stock.

Geum coccineum 'Mrs. Bradshaw.'—A really beautiful and recent addition to this class of Geums, growing up to 3 feet in height, with conspicuous scarlet flowers. The majority, if not all Geums, come practically true from seed, and the variety 'Mrs. Bradshaw' is no exception. They are also readily increased by dividing the crowns at planting time either in autumn or spring. The seed is best sown in nursery beds in April or May, or earlier under glass; and if transplanted as soon as large enough to handle, will make strong plants by the autumn.

Lobelia siphilitica.—A variable species, of robust and hardy constitution if grown on a free moist soil. It has blue flowers, and

attains a height of 3 feet. The most easy way of propagation is by division in spring.

Astrantia major.—A very distinct and pretty European species, now naturalized in the woods around Ludlow and Malvern. The flowers appear in June and July, white or pink, with bracts which are white beneath and green above. The plants are best increased by division in early autumn or spring. If by seeds, they are best sown as soon as ripe in cool frames, transplanting the seedlings the following spring.

Inula Royleana.—This is undoubtedly the finest of its species *; it has yellow flowers, blossoming about July, and grows about 18 inches high. To increase the plants, pieces of the roots 2 inches long, as in *Statice latifolia*, can be taken and inserted. Also by dividing the crowns of the plants.

Veronica spicata, from which the *V. spicata alba* mentioned before is derived. It is similar in appearance, except that the spikes of flowers are blue instead of white.

Hieracium villosum.—A handsome hairy perennial, 1 foot high, with silvery foliage and yellow flowers, appearing in July. These plants can be increased by dividing up the tufts in early autumn or spring, or by sowing seed in an open border, as soon as ripe.

All the attention needed by this *Hieracium* is the dividing of the clumps every two years, as it grows very rapidly and is at its best in the second year after division.

Stokesia cyanea is the last plant of all I have as an example. It is an invaluable plant for a hot and dry situation, and grows 18 inches in height. In September it bears large, showy, blue flowers, somewhat similar in appearance to a China Aster. It is increased by division in spring and flourishes best in a good warm soil, but, owing to its naturally late season, unfortunately does not always bloom as well as it otherwise might.

In all probability more than one plant would not suit the idea of everyone as a true subject for a hardy herbaceous border. That is as it may be. What is and is not an herbaceous plant, and whether a certain plant is or is not a suitable subject for this kind of border, has long been a subject of controversy, and it should be left as much as possible to the taste of the person to whom the said border belongs to settle the question.

* Genus.

INSECTS ATTACKING APPLE, PEAR, PLUM, AND CHERRY TREES.

By G. FOX WILSON.

It is essential, in dealing with and destroying pests of any kind, to have a thorough knowledge of their life histories, so as to know the exact time to apply the preventive, as there is often only one period in the life of an insect when it is vulnerable.

Let us now see what the word "insect" implies. It literally means any animal which has the body so divided as to seem cut into successive parts, usually resembling rings of hard substance connected by soft skin.

In old entomological books it will be seen that "insects" was the name given to all animals with bodies resembling a row of joints; even worms and slugs were at that time included.

Now the name is confined to a considerably smaller group of animals, the true insects, or the class Insecta of the type Arthropoda.

In this diminished sense, insects are now classed as animals that have a jointed body made up of a number of rings of horny substance called chitine, connected by skin, so united as to form three great divisions in the body, viz. the head, the thorax, and the abdomen.

The head of an insect consists of four segments, which are so fused together as to be undistinguishable in the adult form.

The head always bears one pair of organs, called antennæ, near the eyes. Their function is not clearly understood, but they act, possibly, as organs of hearing, smelling, or feeling, or perhaps of another sense, of which the human being does not know.

The length of them varies greatly, as does also the number of joints in them, and insects can often be readily recognized by the shape or number of joints in the antennæ.

The eyes of insects are of two kinds, simple and compound. The former consists of a single eye, and is situated, in the mature insect, on the upper part of the head. There may be from one to three of them, the latter number being the most met with.

The compound eyes are made up of the union of a large number of hexagonal simple eyes, as many as thirty thousand. They are often so large as to occupy the greater part of the head.

The mouth parts consist of the upper lip or labrum, two pairs of jaws or mandibles, maxillæ, and the under lip or labium.

The labrum is narrow and of a chitinous nature, closing the mouth from above.

The mandibles or upper jaws are fixed on either side of the opening of the mouth and move horizontally.

The maxillæ or under jaws are fixed immediately behind the mouth, and they bear inner and outer palpi resembling lobes.

The labium is fixed on the under side of the head, and also bears palpi, which are known as labial palpi.

The mouth parts of different insects vary considerably, according to whether they are carnivorous or herbivorous; in different cases certain parts are more in evidence than others.

The thorax consists of three segments, to each of which a pair of legs is fixed.

To the second and third segments, in winged insects, a pair of wings are attached, except in the order Diptera, where the hind wings are very rudimentary.

Often the hind wings are coupled to those in front by means of hooked hairs, and the wings of many insects, including the order Lepidoptera, are covered with scales.

The legs of insects help very much in their classification, and consist of five parts, which are:—

The coxa, or joint by which the leg is attached to the thorax.

The trochanter, the next joint and usually very small.

The femur, the stoutest joint of the leg, and longer than the first two.

The tibia, the longest joint and usually very hairy.

The tarsus or foot, consisting of from one to five segments, the last joint being furnished with claws or cushions.

The parts of the leg are often different, according to whether the insect digs, springs, &c., being various parts modified according to function.

The abdomen may consist of as many as ten segments, which may be movable or fixed.

This region rarely bears any appendages, and ovipositors, forceps, and bristle-like structures are the only ones borne on this part.

The description here given is of a mature insect, as larvæ and pupæ bear more legs, and some are borne on the abdominal segments, such as the prolegs, &c.

Metamorphoses of Insects.—The insect always begins life as an egg, except in rare cases where “budding” is resorted to in the Aphides, and is not, as at one time was thought, produced by spontaneous generation from dead and decaying substances.

The eggs vary in size and shape, according to the insect, and the shell may be smooth or sculptured.

They are deposited singly or in groups, in contact with or very near a sufficient supply of food for the nourishment of the young larvæ, and thus many insects deposit their eggs on leaves, others in stems or under the bark, as will be seen.

The number of eggs deposited by a single insect varies from twelve, or even less, to fifty thousand, most insects laying from fifty to one hundred and twenty.

After a time, a tiny creature comes forth known as the larva,

caterpillar, grub or maggot. The general rule is to confine the term "caterpillar" to the larvæ of butterflies, moths, and sawflies, "grub" to the larvæ of beetles, and "maggot" to the larvæ of flies.

The three segments behind the head correspond to the thorax of the perfect insect or imago, and, if any legs are present, a pair is borne on each of these segments.

Legs are also often present on the posterior segments; these are known as prolegs; they are not jointed, and have fringes of bristles instead of claws.

There are mainly five pairs of these prolegs on the larvæ of butterflies and moths, and eight pairs on sawflies' larvæ.

The head and fourth body segment never bear any kind of legs.

A larva, such as a caterpillar, possesses a head and twelve other segments. It is difficult sometimes even for experts to know to what insect the larva belongs on account of the moultings, as it usually moults five times in its existence as a larva.

It is at this stage when the pest is worst, as the larva eats enormously and is therefore most destructive.

Food assimilates quickly to be stored away for the pupal stage; the caterpillar or larva also quickly grows, and, as the chitinous covering will not stretch much, the larva bursts it and so moults. The next stage is the pupal or chrysalis stage, where the insect takes* in no food, but lives entirely on a store of fat accumulated during the larval stage.

In due time the membrane or case containing the pupa cracks, and the imago or perfect insect creeps out to lay its eggs and reproduce its species like its predecessor.

When insects undergo the above changes, they are known to be metamorphic, and insects belonging to the Coleoptera, Diptera, Hymenoptera, Neuroptera, and Lepidoptera undergo these changes.

Where, however, it is difficult or impossible to see these changes, the insects are known to be ametamorphic, and this is the case in the Hemiptera and Orthoptera.

The fact that insects are produced from parents renders it of the utmost importance, when dealing with injurious species, to become acquainted with the habits of the females as well as of the larvæ, which latter are the destructive agents, and are the more generally observed by gardeners, who can, by watching the life histories of these insects, destroy them in greater proportion.

The larvæ, during their rapid growth, are more destructive to vegetation than are the perfect insects, but among the groups provided with a mouth suitable for chewing, as the Orthoptera, or for puncturing the tissues of plants and sucking their juices, as the Rhynchota, particularly the Aphides, the perfect insects may be also as destructive as the larvæ.

The insects provided with "biting" mouths are generally hardy and invulnerable, and are not injured by a wash quite strong enough

* Except in the case of those insects which have active "pupæ."—F. J. C.

to injure the plant they are feeding on, and so must be dealt with as vermin, viz. by placing a small portion of a very powerful poison on the affected plant.

There are only three good poisons for this purpose, which are Paris green, London purple, and lead arseniate.

The sucking insect is the more vulnerable, and can generally be killed by spraying with a wash, which will close up the breathing places or spiracles on the sides of their bodies, and, as they suck the juices from within the plant, this is the only way of killing them.

Spraying.—It is often seen recommended that spraying should be done not only as a cure but as a preventive, but this is only in the case of fungi, as it is quite useless and a waste of time and money to spray when the insects are not there.

Not only should the orchard be sprayed, but also the surrounding hedgerows, palings, and forest plantations, that help enormously in acting as breeding-grounds for insects such as the winter moth, lackey and little ermine moths, and scale insects, besides many others. Knapsack sprayers are best for small orchards even up to two or three acres, and not garden syringes, as these do not distribute the insecticide evenly on to the tree, and have also to be filled continually, but not so with the knapsack sprayer.

For large orchards and fruit farms, a large machine must be used that runs on wheels and has a pump handle that one man alone must work.

The wheels should be large, so that a greater amount of ground can be gone over than in a small-circumferenced wheel.

The tyres should be wide, so that the wheels would not sink into the ground, especially on clayey or porous ground.

The size of the machine will vary with the size of the plantation. The best machines of this size are those made by the "Four Oaks" Company. Machines should be made of brass, copper, or wood, and if of wood, water should be kept in them to prevent warping.

When buying a sprayer, whether large or small, always see that the pumps are well packed, and that there is a sufficiently large air-chamber to cause a good pressure, and see that there is an agitator in order to stir up the sediment in some of the washes. The chief thing to be studied in spraying is the nozzle, and it should be made so that the water, on passing through, is broken up into the finest spray possible, and as much resembling a Scotch mist as possible.

A fruit farmer, who is a sprayer, of course, holds the following proverb: "The finer the spray, the better the results."

Besides spraying for pests, many other means are used, such as picking the larvæ off the leaves and putting them in hot water. Chopped "lights" of sheep are deposited on the ground to catch carnivorous insects such as weevils.*

* "Ground beetles" is meant, one or two species of which attack ripe strawberries.—F. J. C.

A lamp is often taken into a fruit plantation at night, when the codling * and male winter and many other moths will fly to the light, and may so be caught and destroyed.

The trees are often shaken over a sheet placed under them, when insects and larvæ will fall into it, and be so destroyed.

Grease banding is also a trap for the female winter moths, who cannot fly, but walk or crawl.

Spraying, however, is now the common and the best remedy for insect and fungus pests.

Clean cultivation, such as keeping the plantation free from weeds and rubbish, does away a great deal with insect pests, although, not wholly.

Birds such as the lapwing or peewit, gulls, rooks, butcher-birds, robins, thrushes, hedge sparrows, missel-thrushes, flycatchers, house martins, swifts, tits, sand martins and kestrels are all birds that live mainly or partly on insects. The peewit is the most useful, but is gradually decreasing.

All these birds should be encouraged—but not in too great numbers, as they will, perhaps, then do damage—by the fruit farmer, as they will do a great deal in keeping down insect pests. Also such insects as lady-birds, carnivorous beetles, wasps, ants, earwigs, and the larvæ of the lacewing and hover flies, are all very useful, the first insect especially, as it eats aphids on fruit trees.

It is waste of time and money if the spraying is not thoroughly done and every part of the tree wetted.

After a heavy rain, the tree will probably have to be sprayed again, but the rain is often beneficial, as it distributes the insecticide over parts which otherwise might not have been wetted.

Fumigation with hydrocyanic acid gas is getting more common, especially for cleaning young nursery stock before it is being sent out. It is certain death to the insects, and it is mainly used for red spider, scale, American blight, and mealy bug.

For fumigating pot trees in houses, it is comparatively easy, provided you have the machine for dropping the sodium cyanide into the sulphuric acid and water, with which machine you do not have to go into the house, but by pulling a string passed through the keyhole the apparatus can be used, all ventilators and doors shut meantime.

Fumigating trees in a plantation is more difficult, as you have to move a tent about.

The trees can be fumigated individually or a few together, according to the size of the tree and tent, and the distance the trees are planted apart.

The chemicals used are sodium cyanide, sulphuric acid, and water.

The proportions cannot be given, as they differ according to the temperature, atmospheric moisture, nature and condition of the

* Codling moths do not go to light.—F. J. C.

plant and the pests to be destroyed, as also does the time of exposure change according to these conditions.

Washes.—Winter washing is very essential every three or four years, as in that time the tree becomes alive with mosses and lichens, which are excellent shelters for the woolly aphis, the apple blossom weevil, the earwig, the larva of the codling moth and its cocoon, besides many other insects.

Insects' eggs, which are about at the time you winter wash, are impossible to kill or injure by these washes, but their hiding and resting places can be destroyed.

The alkali wash, often used, is of the following constituents:—

Caustic soda, 98 per cent.	. . . . .	2 lb.
Commonest treacle	. . . . .	$\frac{3}{4}$ lb.
Water	. . . . .	10 gallons.

This is a good wash, and should be used about the end of February, and it will often kill also mussel scale.

A wash known as the lime-sulphur spray can be used as a winter wash with good effect.

The constituents are:—20 lb. of quick lime.

36 lb. of flowers of sulphur.

80 gall. of water.

The lime is slaked in a little water and whilst still hot the sulphur is added, and the whole covered with canvas in a wooden vessel. Allow to boil for twenty minutes, stirring occasionally, and then the rest of the water is added. It is further diluted before spraying, and using as a winter wash, one gallon of the wash to 12 gallons of water. This wash kills both insects and fungi.

The recipes given for the insecticides are not always very poisonous to the insects, but more practice is needed and many more experiments will have to be made before the "last word" in spraying is given.

A fruit farmer, or any gardener who takes an interest in horticulture and the well-being of his trees and plants, will keep them free from disease and other ravages.

It is an interesting and helpful plan to study the plants you are growing, and to study the pests attacking them individually. By studying their life histories, whether insects or fungi, you can generally find a way to destroy the pests.

Also experimental work will be well repaid, besides being very interesting, as by this means you might get a wash or spray that is more detrimental to the pest or pests than the wash already being used.

Every gardener should be a botanist and entomologist, and so should the fruit farmer, especially the latter.

I will now take the individual insects and describe them, giving their life histories wherever possible, and the best and most general insecticide used, giving only one remedy for each insect.

In the case where the one insect attacks both trees, I will only mention it once, as the remedy would apply to either of the trees.

I will divide the insects into two sections :—

1. Sucking Insects.
2. Biting Insects.

I will take the former first, which need "contact washes."

INSECTS ATTACKING THE APPLE TREE.

"SUCKING INSECTS."

I. WOOLLY APHIS, *Schizoneura lanigera*. ORDER RHYNCHOTA.

This insect is also known as American Blight and the Apple Root Louse. It is called the former name wrongly, as the insect is of European origin.

It is mostly seen in old and neglected orchards, but unfortunately it is often seen in newly-planted orchards on account of its being sent out with nursery stock.

Its dispersal is by the wind, but it has now become a cosmopolitan pest on account of dirty stock being sent out by nurseries.

The pear tree is also attacked, the young material being generally the most infected.

It is easily recognized by white cottony threads fastened to the limbs of the trees, this substance being excreted from glands by the old and young females.

Trees with a soft rind are most affected, and apples on the crab stock resist this pest more than on the paradise stock, Northern Spy and Winter Majetin being very resistant to its attacks. These aphides pierce the bark with their rostra and suck the juices from the tissues below, finally making the bark to split, this often being the forerunner of the canker fungus, *Nectria ditissima*.

They are seen on the main trunk, the branches and the roots, and only in an overwhelming attack are they seen on the leaves.

The genus *Schizoneura*, to which this aphis belongs, is distinguished by the nerves or veins on the wings. In this aphis, the chief vein of the fore wing gives off three branches, and the branch furthest away from the insertion of the wing forks into two. Also this aphis is devoid of cornicles situated on the abdomen, as in certain other aphides.

There are to be seen four forms in a year :—

1. Wingless females which produce young by a process of "budding."
2. Winged females doing the same.
3. Males without wings which pair with
4. Wingless egg laying females.

The wingless, viviparous females are oval in shape and purplish-brown in colour, having reddish-brown or black antennæ and legs, both of which are very short. These females can be seen almost all

the year round, giving rise to large numbers of young, and it is these that give rise to the woolly festoons often seen on apple trees.

The winged females are seen from July to September, being chocolate-brown in colour, but they are not to be seen in all places. The wingless males and egg-laying females are to be seen towards the end of the year, and have no piercing proboscis. The female is of a reddish-yellow colour, hardly ever longer than $\cdot 003$ of an inch, laying one egg and then dying.

The larvæ from these eggs develop into wingless, viviparous females. Certain authorities believe that there is active migration from roots to trunk and from trunk to roots.

Enemies.—The lady-birds and their larvæ eat great quantities of them, as does the blue tit, a very useful bird. The small dipterous larvæ of the genus *Pipiza* feed on the aphides that attack the roots.

If the pest is very bad a summer wash can be applied, using :—

Paraffin	2 gallons.
Soft soap	$\frac{1}{2}$ lb.
Water	1 gallon.

Boil the water and soap together well, and while still hot pour in the paraffin and churn as thoroughly as possible until a creamy butter-like mass results, and dilute with ten gallons of water for use.

It can be sprayed on in the summer, or a strong paint-brush can be used and work thoroughly with the bristles into the cracks containing the aphids.

For the root louse, inject carbon bisulphide into the soil from October to March, preferably the former month.

A moderate-sized tree needs about one fluid ounce, half of which should be placed about 6 inches in the soil on either side of the trunk and about 2 feet away from it.

Do not make the hole too near a root, as the liquid is detrimental to roots though the fumes do no harm to them. Close the hole made tightly with clay to prevent any fumes escaping, and these fumes will penetrate the soil, killing all the aphides they get near.

2. APHIDES. ORDER RHYNCHOTA.

There are three distinct kinds attacking the apple tree :—

- (a) The apple-leaf aphid, *Aphis fitchii*.
 - (b) The permanent apple aphid, *Aphis pomi*, and
 - (c) The rosy apple aphid, *Aphis sorbi*.
- (a) *Aphis fitchii* does not cause the leaves to curl.

The eggs hatch out about the middle of April, and commence attacking both leaf and blossom buds, the latter becoming brown and finally dying.

In about a fortnight the young reach maturity, and early in June they commence to migrate to various grasses, returning about the middle of September to the apple, on which they deposit their eggs in the axils of the buds.

(b) *Aphis pomi* is a leaf-curling aphid and is common on apple trees. The black, shiny, elongated eggs hatch out in April, and the greenish-yellow larvæ soon commence to attack the newly-opened leaves. After casting their skins three times they develop into viviparous females, which at once produce living young, by a process of "budding," and these soon grow.

The leaves now curl up, on account of their punctures caused by the piercing proboscis of the aphid.

About the middle of July the pupal stage is reached, and soon afterwards winged viviparous females appear, which give rise in the autumn to wingless males and females, the latter depositing their eggs in November on the young shoots and in the axils of the twigs.

c. *Aphis sorbi* is only very little understood at present. It migrates from the apple in June or July, returning to it in the autumn.

The leaves curl up, on account of the punctures made, or blister, and have a reddish colour.

The lady-birds and their larvæ eat enormous quantities of all these aphides.

Insecticides.—Winter washing is only partly good in destroying these pests. Also, if you have let the leaf curl up, it is useless and waste of time and labour to spray, as the liquid cannot possibly get to the insects.

Before the leaf curls up, spray with tobacco water made by steeping 2 lb. of tobacco in 9 gallons of water for several hours. Dilute this when using, adding 1 gallon of the preparation to 3 gallons of water.

Be sure to spray before the leaves curl.

Also keep the plantation clear of weeds and clovers, as these are plants the aphides migrate to.

3. THE APPLE SUCKER, *Psylla mali*. ORDER RHYNCHOTA.

The larva of this insect is very small, being closely concealed in the buds, on account of which its presence is not easily observed. The damage done to the leaf and flower buds is often put down to the work of the aphid, which is about at this time and is much more easily seen than the *Psylla*.

This pest has been known in Britain for several years, but it is only just lately it has been recognized as a serious pest. There is an allied species in America called *Psylla pyricola*, which does a great amount of damage to the pear trees. The perfect insect is seen from the middle of May until the end of June. It is of a green colour with shades of yellow, but the colour varies according to the sex and the time of year. At breeding time the female is distinguished by being more brightly coloured than the male. The wings are transparent, and the legs and antennæ are yellow, the latter having two or four dark-coloured joints at the end. The female is about one fifth of an inch long, the male being slightly smaller. The larvæ are very small at first, having flat yellow bodies with brown

spots on them. The eyes are red, the feet being brown. The eggs are white or pale yellow and rather spindle-shaped, with a thread-like arrangement at the pointed end, by which the eggs are placed on the tree. They become red before the larvæ emerge.

Pairing takes place in September, and egg-laying is continued until November. The eggs are generally laid singly, being embedded in the fine hairs upon the epidermis of the shoots, and placed usually on the lower shoots. When the weather becomes warm in April, the tiny flat larvæ emerge from the eggs and move to the nearest buds, and the leaf and flower buds are attacked, the latter being the most attacked, and they do not expand and the fruit fails. The larvæ soon make their first moult, and there is seen protruding from them a small white globule, which remains attached by a white thread to its body, and if it is removed another one speedily forms.

The larvæ, in a few days, emerge from a second moult as light green with numerous white threads with which the larvæ cover themselves. After a lapse of a week another moult is performed, when the rudimentary wings are formed, and their eyes and antennæ's tips become dark, and this is known as the nymph stage. This stage usually lasts about one month, in which time they undergo several changes.

After this the nymph moults and the imago appears in May and June, and is said not to pair until the following September.

Insecticides.—Spray in April and when the larvæ are about with $1\frac{1}{4}$ oz. of nicotine to 10 gallons of water.

The poison does not injure the blossoms, and is not injurious to bees. Also a great many eggs can be destroyed by cutting out pieces of wood, when pruning, that have a good many eggs on.

This, however, can only be performed on young stock, as it would be almost impossible in the case of large orchard trees.

4. MUSSEL SCALE, *Mytilaspis pomorum*. ORDER RHYNCHOTA.

This insect also attacks the pear, currant, and plum.

It is found in all our Colonies, where it has been taken by nursery stock. It is found abundantly in old and neglected orchards, and is very injurious to young stock.

The insect damages the tree by sucking out the sap by means of a long flexible proboscis, which it inserts into the tissues of the plant.

It occurs on all parts, trunk, limbs, leaves and fruit.

The "scale" is often mistaken for growths on the bark, but it is a product, as in all Coccidæ, formed by the insect that lives beneath it, partly by excretions from the body and partly by the cast skins of the insect.

The female scale insect is about one eighth of an inch long, conical shaped, being either straight or curved. It is of a dark-brown colour, fleshy, legless, and provided with a long flexible proboscis. The male scale insect is much smaller, and is provided with two large

wings. The larva is about one hundredth of an inch long, minute, active, with six legs.

The eggs resemble white dust, and are almost microscopical. Numbering up to eighty, they are laid under the female scale.

In early summer, the six-legged larvæ appear and, crawling from beneath the scale, may be carried from tree to tree by wind, birds, or certain insects, such as the lady-birds.

In a few days they fix themselves to the plant by means of their short proboscis, and suck away the juices. The scale soon forms from a few waxy threads being excreted, and during this time the larva becomes legless and fleshy.

At the end of summer the female lays her eggs and dies, leaving her shrivelled skin beneath the scale.

If the larva is to become a male insect, which is very rare, a different scale is produced and a different mature insect appears.

The larva of a male undergoes a kind of pupal stage, after which the winged form appears.

Insecticides.—Spray with the caustic winter wash, before given as a good wash. Also steep 2 lb. of tobacco for several hours in 9 gallons of water, and dilute this according to the quantity of scale you have, and spray with this in June.

If, however, the pest is very bad, fumigate the trees with hydrocyanic acid gas, using a tent over the tree, as before explained.

5. THE OYSTER-SHELL BARK LOUSE, *Aspidiotus ostreaeformis*. ORDER RHYNCHOTA.

This insect also attacks the pear, plum, cherry, and currant. It resembles very much the former insect as to the formation of the "scale." The female scale attains a diameter of one twelfth of an inch, being round, smooth, and rather flat. The central part of the scale is dark, the rest being of a yellowy-brown colour. If overcrowding occurs, the scales are much smaller.

The adult female is flat, round, and yellow, and is devoid of eyes, legs, and wings, with only rudimentary antennæ.

The male scale is much smaller, being about one twenty-fifth of an inch in diameter. The adult male is orange-yellow in colour, with a dark band across the thorax. It has antennæ, legs, and two wings, but is devoid of a functional mouth. The male pupa has no mouth organs, but has antennæ, legs, and signs of wings; it is yellow, with black eyes and ocelli.

In the second stage of the male and female, the insects are without wings or legs, and remain attached to the bark by their rostra.

The larva from the egg is quite minute, but active, with one pair of jointed antennæ of six joints, six legs, and a sucking mouth.

The winged males appear in May, and by that time the females are adult.

The eggs are laid, and very soon the larvæ hatch out and wander

over the bark, finally attaching themselves to it with their rostra. The larva secretes a substance which covers it, and soon it moults. The moulted skins go to form the scale over the insect's back. Hibernation takes place in the second immature stage. The April following, the second stage males pass into the pupal stage, which lasts three weeks, and then the adult males emerge. At the same time, the second stage females go through their last moult and emerge, when they pair with the adult males.

Insecticides.—Fumigate the trees with hydrocyanic acid gas.

Winter washing with the caustic preparation, before mentioned, will cause many scales to wither and get stuck to the bark, in which case they cannot breathe and so die.

For summer spraying a paraffin emulsion is best, using:—

Soft soap	2½ lb.
Paraffin	20 ounces.
Water	9½ gallons.

Churn the paraffin thoroughly with the water and use as soon as possible, for if kept the paraffin will separate out.

“BITING INSECTS.”

I. CODLING MOTH, *Carpocapsa pomonella*. ORDER LEPIDOPTERA.

This insect also attacks the pear and plum.

It is not, as its name suggests, confined to codlin apples.

Great care should be taken in storing apples to see that they are not infected at all, for if they are the larvæ will crawl out of the fruit, pupate in the cracks of the fruit room, and the moths will fly out and attack the apple trees the following year.

The moth is small, being about three-quarters of an inch across the spread wings, and one-third of an inch in length. The fore wings are deep grey, with several wavy brown lines, and at their extremities are oval patches of a deep golden colour, this marking identifying this moth. The hinder wings are darker, having a golden tinge and a lustrous shimmer. When the moth is at rest, during the day-time, on the trunks and branches of the apple, &c., it folds its wings in the form of a roof over its body.

The larva is at first white in colour, with a shiny black head, three pairs of claw feet, with four pairs of sucker feet in the middle of the body and a pair at the end. When full grown it is three-quarters of an inch long, the head then being brown and the body flesh-coloured.

The pupa is yellowy-brown, with spines on the abdominal segments, which are used for pushing the pupa out of its cocoon.

The egg is flat and oval and as large as a pin's head, white when laid and having a reddish ring on it later.

The moths appear at the end of May, flying about in early evening.

The females, at this time, lay their eggs on the apples, when they are about half an inch in diameter.

The larvæ hatch out and make their way to the "eyes," and three weeks cover the larval stage.

After the larva has eaten the seeds, &c., it bores a hole to the rind, through which it escapes; then, if the apple is hanging, the larva makes its way to the ground, where it hides, or perhaps it will hide in the bark. It will hibernate, in the soil or on the stem, by constructing cocoons with little pieces of bark knit together with silk, or they may even get into a crevice in the bark and surround themselves with a silk case covered over with a sticky fluid. The larva does not usually pupate until the spring, and there is normally only one brood in a year, but sometimes two.

They bore into the fruit, causing it to drop before ripening, and the fruits are often described as "worm-eaten." Upon examining an infected fruit, there will be seen a dark spot at the blossom end of the apple; a small hole can be seen here, around which there is a collection of excreta and minute portions of apple. On cutting the apples in half, a passage will be seen leading to the core, and it will also be seen that the seeds or part of them have been eaten, generally by the larvæ.

Varieties of apples having deep, open "eyes," and large dried tufts of calyces surrounding them, are more liable to the attacks of this insect.

Insecticides.—All fallen apples should be picked up and burnt, and all "maggoty" apples should be separated from the sound ones on gathering, and also burnt. All rough bark should be scraped off preliminary to putting haybands round the stem in July, about one foot from the ground, leaving them on until the winter, burning the bands then, as they will contain many cocoons and larvæ.

Spray the trees three weeks after the petals have fallen, in order to get poison into the eye of the apple to poison the larva's food, with Paris green, made by mixing 1 oz. of Blundell's Paris green paste to 12 gallons of water. Keep it well agitated while using.*

2. WINTER MOTH, *Cheimatobia brumata*. ORDER LEPIDOPTERA.

This attacks also the peach, pear, cherry, damson, gooseberry, apricot, and nut.

About the second week in October the two winter moths come from chrysalids in the ground, under or near the trees that were infected with larvæ the preceding summer.

The male moth measures from one to one-and-a-half inch across the spread fore wings, which are grey-brown in colour, with darker wavy lines, the hind wings being pale grey, but devoid of markings.

The female moth has such small wings that flight is impossible, so that it crawls up the stem to lay its eggs. It has a large abdomen, with conspicuous long legs.

* Lead arseniate is a safer material to use.—F. J. C.

The great winter moth or the mottled umber moth, *Hibernia defoliaria*, is about twice the size of the winter moth.

The male has pale brown fore wings, each with two dark bands, the hind wings being paler, with a brown spot near the middle. The wings of the female are abortive, the brown body having two dark spots on each segment; whilst the male's antennæ are combed, the female's are simple.

The eggs of the winter moth are very small, cylindrical, of a light green colour, changing to red. They are placed in small groups usually at the bases of buds or on pruned surfaces, and fastened thereto with a glutinous substance. From one hundred and fifty to two hundred are laid by one female. The great winter moth lays larger, light brown, long eggs and as many as four hundred, being placed in lines or small groups.

The larvæ hatch out about the middle of March and just before the buds burst.

The winter moth larvæ are at first grey, with dark heads. Later they become greenish, with white stripes and brown heads, being when adult three-quarters of an inch long. They have six legs and two pairs of prolegs, one pair of these being at the hind part of the body. The larvæ eat buds, leaves, blossoms, and fruit. When they are fully fed in June, they let themselves down to the ground by means of silken threads, and bury themselves.

The moths are seen from early in October until January.

The larva of the great winter moth is brown, with a wavy dark stripe on each side of the body, and being one and a quarter inch in length. They both feed on the same trees.

Insecticides.—Grease banding is resorted to, as the female cannot fly.

Use grease-proof paper and smear it well with cart grease, tie these, six to eight inches wide, eighteen inches up the trunk, and first tie at the bottom so that you can double the bands round, forming an impassable road up the stem.

Put these bands round the first week in October, and renew the grease as it gets washed off, and in February take the bands off and burn them as they will contain numerous females.

This, however, is insufficient, so spray between the middle of March and the middle of April with 1 lb. of Paris green paste to 200 gallons of water.*

3. LACKEY MOTH, *Bombyx* OR *Clisiocampa neustria*.

ORDER LEPIDOPTERA.

This insect also attacks the pear and cherry, and such forest trees as the oak and elm.

The moths vary very much in colour; the upper wings are usually brown, tinged with red or yellow, crossed by a darker band with pale bars; the fringes along the hind margin are alternately pale and dark.

* Use lead arseniate.—F. J. C.

The lower wings are usually reddish-brown, with an indistinct paler crossbar. They are seen in July and August.

The female lays her eggs arranged spirally on twigs, and by this position of the eggs the pest can always be noticed. They are laid early in August, one female laying from three hundred to four hundred eggs.

The larvæ hatch out the following April, and are then black. For a long time they live in companies, from thirty to one hundred in a company, spinning a web over themselves, going out to feed on the foliage, but returning to the webs at night or when it rains. When nearly adult, they wander apart by themselves, being then one and a half inch long and gaudily covered with long hairs, having a bluish grey head with two black spots on it resembling eyes.

The next segment is grey-blue in colour, with four black spots on it, and the other segments are like this one, striped with white down the middle of the back and with scarlet, blue, and black on the sides. When adult, they get in crevices in the bark or in other cracks on the tree, on adjacent hedges, or under any rubbish that may be about. The pupa is smooth and brown, enclosed in an oblong yellow cocoon, with which a sulphury powder is mixed.

The eggs are greyish brown, arranged in bands about one and a half inch along the young twigs, and can be seen throughout the winter. This pest is easily recognized on account of the position of the eggs and the gaudily coloured larvæ.

Insecticides.—Caustic winter washes do not destroy the eggs, so that twigs seen to have them on must be pruned off and burnt.

Shake the trees, when the larvæ are in their clusters, and destroy all those that fall into a sheet spread under to catch them.

Keep the ground all round quite free from weeds, so as to take away a place in or on which the pupal stage can be passed. In May or June go round all the trees with a bucket containing some strong insecticide, and when the webs and clusters of larvæ are seen cut the affected shoot off and dip it straightway into the bucket.

4. THE PITH MOTH, *Blastodacna hellerella*. ORDER LEPIDOPTERA.

The larva of this moth causes considerable damage in apple orchards, and is distributed from Lancashire southwards.

It is often confused with the bud moth, but the larvæ of the bud moth spin the leaves together, making leaf-nests, whereas the larvæ of the pith moth do not.

The moths belong to the group Tineinæ, having narrow wings bordered with long fringes, and the fringes most marked on the lower wings. The moth varies in size, with a leaf expanse of two to three fifths of an inch. The front wings are nearly black, with white streaks and scales, the hind wings being grey, with long delicate fringes.

The larva is red, having the head and the first and last segments deep brown, the next two segments are pale brown, whilst the abdominal

segments have six brown bristle-bearing spots. When adult, it is one-third of an inch long.

The pupa is red in colour; the head and the front of the thorax and the tip of the body are mahogany red. It is cylindrical in shape about one-quarter of an inch long, having black eyes, long and pointed wing cases, and long legs.

The moths are seen in July, when the eggs are laid on the leaves. Before winter the larvæ bore into the shoots and hibernate just below the outer bark, the position being marked by the presence of a small blister and a clear round hole opening into or near the blister mark.

Early in the next year the larvæ tunnel up the pith of the shoots and the fruit spurs.

They are mature by the end of June, when pupation takes place in the tunnelled shoots, after which there can be often seen the empty pupa-case projecting from the dead shoots.

Insecticides.—By winter-pruning the wood thus infested can be cut away, the hole in the stem or shoots being a guide where to cut. Or get a piece of thin and fairly pliable wire with a pointed end, and thrust it into the holes, and when the larvæ are brought out on the end of the wire put them into boiling water or a strong insecticide. Also inject into the holes, in April to June, a paraffin emulsion made with

2½ lb. of soft soap.
2 oz. of paraffin.
10 gall. of water.

Keep the liquid in constant agitation in order that the paraffin may not separate out. By injecting this, it will poison the larva's food.

5. THE VAPOURER MOTH, *Orgyia antiqua*. ORDER LEPIDOPTERA.

This pest also attacks the pear, plum, apricot, strawberry, and a host of other plants, including nearly all the forest trees.

It is seen in towns nearly as much as in the country, its distribution extending over Europe, Northern Africa, and Western Asia.

The male and female moths differ considerably. The male measures from one to one-and-a-quarter inch in expanse of the wings; the body is brown, as are also the wings, the fore wings having dark markings on them, and near the hind angle of these wings is a crescent-shaped white spot; the antennæ are double-combed. The female is yellow-grey in colour, hairy, and cannot fly, as the wings are reduced to mere stumps; the antennæ are single-combed.

The eggs are whitish-grey in colour, almost round, with a flattened upper side, and are laid in great numbers.

The sixteen-footed larva is very hairy, its colour being light; also tufts of yellow or brownish hairs are very conspicuous on the back about in the middle, two tufts being on each segment.

Also there are two dark-coloured tufts springing from behind the

head and pointing over it, and also a similar long tuft at the tail. When adult it is two inches long, and is seen from May to September. The chrysalis is yellow, and lies under an oval-shaped yellow-grey web, in which are to be seen the hairs of the larva.

The males are easily observed on account of their active flight.

When the female emerges from the cocoon, it settles on the outside, and lays three hundred or more eggs on and around the cocoon. Most of the eggs hatch out in two or three weeks, but many do not hatch out until late spring the following year.

When the larvæ are adult they spin their cocoons, which are attached to leaves or twigs, or even crevices in the bark.

Two broods in the same year are quite common, and all stages of the insect from egg to adult can be seen at the same time.

Insecticides.—Remove and destroy all cocoons when found, especially those with eggs on them, or those found in winter.

Also spray when the larvæ are seen with 5 lb. of lead arseniate to 100 gall. of water, this spray poisoning the larva's food.

6. THE GOAT MOTH, *Cossus ligniperda*. ORDER LEPIDOPTERA.

The moth is mottled grey and brown, with a wing expanse of three to four inches.

The eggs are laid on the trunk, from the base of the tree to a height of seven feet, in the middle of summer.

The larvæ are mahogany-red on the back and dirty yellow on the sides.

They are three inches long when adult, and live for three years.

They bore their way into the stem of the tree, and feed on the tissues.

Their presence may generally be observed by a heap of reddish excreta on the ground near the stem, the large holes in the bark, and the fearful odour they emit.

Insecticides.—Smear the base of the stems with clay and cow-dung to prevent the moth laying its eggs there.

Push a piece of pointed, pliable wire up the passages and tunnels in the tree, and you can thus get the larvæ.

Place a piece of potassium cyanide in the openings of the holes, and close these with clay, and so the fumes will kill the larvæ.

7. THE SMALL APPLE ERMINE MOTH, *Hyponomeuta malinella*. ORDER LEPIDOPTERA.

The moth has a wing expanse of one inch.

This pest resembles the lackey moth insomuch that the larvæ live in colonies in web-nests.

The eggs are laid in roundish yellow or brown patches on the twigs, and are protected with a covering of gum.

The larvæ emerge in October, being minute, having yellow bodies with black heads.

They hibernate under the covering which protected the eggs, and emerge when the leaves expand.

They burrow into the leaves, living concealed until late spring or early summer, when they eat their way out, and begin to feed on the surface of the leaf; they then collect together and build their web-nests.

Insecticides.—The same as for the lackey moth, that is:—

To prune off twigs having the eggs on.

To take the web-nests and put them into some strong insecticide.

To keep the ground round about free from weeds and rubbish.

8. THE APPLE BLOSSOM WEEVIL, *Anthonomus pomorum*. ORDER COLEOPTERA.

This insect also attacks the pear tree.

This pest gives a result that used to cause many fruit-growers to put the attack down to white frosts, but on examining an infected blossom the little white larvæ are to be seen in the centre of the flowers destroying their power of fructification, the flowers easily dropping when the tree is shaken.

The weevil is about one quarter by one eighth of an inch in length and breadth, being of a black colour.

The wing-cases or elytra have alternate bare and pubescent grey lines, and when closed a characteristic V-shaped mark is to be seen.

The legs are almost black; the thighs of the first pair are large and each is furnished with a tooth, and the middle and hind pair also have a tooth but smaller, the feet being of a very dark red colour.

The rostrum is half as long as its body, slightly curved, and bearing the antennæ, which end in oval four-jointed clubs.

The eggs are yellowish and oval.

The larva is about one third of an inch long and legless, having a brown head with two little brown spots on the first segment.

When adult it is wrinkled and creamy white.

The pupa is nearly one quarter of an inch long, of a pale yellow colour, with a long rostrum, and the legs folded on the under side of the body.

The female bores a hole in the flower in the spring, puts one egg within each blossom bud, and closes up the hole.

The female lays from fifteen to fifty eggs, putting only one in each blossom, always depositing her eggs in the flower buds and never in an open flower.

The larvæ emerge in about ten days, and eat the carpels and the stamens, causing the flower buds to die and drop off.

The larvæ turn into pupæ in eight to twenty days, in which state they last from seven to ten days, when the weevil appears and escapes by a hole made in the petals.

The weevils are said not to eat, but live upon a store of fat stored up in their bodies during the larval stage.

They hibernate in September, going into some hole in or near the tree.

Insecticides.—Winter washing with caustic washes destroys harbouring places for the weevils on the trees.

Shake the trees on a calm summer day, placing tarred paper around the trees to catch the weevils, and then burn them.

Keep the surface of the ground free from weeds and rubbish.

9. THE APPLE SAWFLY, *Hoplocampa* OR *Tenthredo testudinea*.

ORDER HYMENOPTERA.

This insect is a very bad pest of the apple, the damage it does often being put down to the codling moth.

The larvæ, in feeding, hollow out the young apples or make irregular tunnels in them.

Brown crumbly excrement pours from the hole in the side of the apple, thus causing the fruit to drop when as large as a walnut, but by this time the larva has left the fruit.

The presence of fallen apples is a sign of the pest being present.

It is found throughout the apple orchards of Europe.

The sawfly is reddish-yellow in colour, with the top of the head, the body between the wings, and the upper surface of the abdomen black.

The antennæ are yellowish, having the middle joint's upper surface darker.

The wings are clear, with the basal veins dark, while a spot about the middle part of the edge of each fore wing is also dark.

It is one quarter of an inch long, with a wing expanse of five-eighths of an inch.

The larva is cream-coloured, and when quite young has a black head and a black plate at the tail end, but later the head becomes reddish-brown, and the tail plate greyish.

When adult, it is half an inch long with twenty legs, whereas the larva of the codling moth has sixteen legs.

The pupa is covered with a yellowish cocoon with adhering soil grains.

The sawflies emerge from the cocoons in May and June, and may be found in great numbers amongst the blossoms.

The eggs are laid near the ovary, and in the young apple the larvæ feed.

The larvæ may leave the fruit before it falls, or may fall with the fruit; however, the larvæ bury themselves some inches in the soil and spin their cocoons, and in this way they hibernate.

Insecticides.—Pick up and burn all fallen apples, as they might contain the larvæ.

Fork "Vaporite" into the soil in spring just before the sawflies emerge in order to kill them.

Spray, as soon as the blossoms are over, with 5 lb. of lead arseniate to 100 gall. of water.

The pests given are the most important ones attacking the apple, but some others are given below.

1. Wood Leopard Moth, <i>Zeuzera aesculi</i>	.	Order	Lepidoptera
2. Goat Moth, <i>Cossus ligniperda</i>	. . . . .	"	"
3. Gold Tail Moth, <i>Porthesia similis</i>	. . . . .	"	"
4. Lappet Moth, <i>Lasiocampa quercifolia</i>	. . . . .	"	"
5. Pale Brindled Moth, <i>Phigalia pilosaria</i>	. . . . .	"	"
6. March Moth, <i>Anisopteryx aescularia</i>	. . . . .	"	"
7. Green Pug Moth, <i>Chloroclystis rectangulata</i>	. . . . .	"	"
8. Figure of Eight Moth, <i>Diloba caeruleocephala</i>	. . . . .	"	"
9. Common Tortrix Moth, <i>Tortrix ribeana</i> and <i>T. viridana</i>	. . . . .	"	"
10. Apple Leaf Miner, <i>Lyonetia clerckella</i>	. . . . .	"	"
11. Cherry-tree Stem Borer, <i>Semasia woerberiana</i>	. . . . .	"	"
12. Rose Chafer, <i>Cetonia aurata</i>	. . . . .	"	Coleoptera
13. Cockchafer, <i>Melolontha vulgaris</i>	. . . . .	"	"
14. Garden Chafer, <i>Phyllopertha horticola</i>	. . . . .	"	"
15. Green Leaf Weevil, <i>Phyllobius maculicornis</i>	. . . . .	"	"
16. Brown Leaf Weevil, <i>Phyllobius oblongus</i>	. . . . .	"	"
17. Cuckoo-spit insect, <i>Aphrophora spumaria</i>	. . . . .	"	Rhynchota
18. Plum Bark Beetle, <i>Scolytus rugulosus</i>	. . . . .	"	Coleoptera

These pests are minor and can be easily dealt with.

When the larvæ are seen, spray with 4-6 lb. of lead arseniate to 100 gall. of water. This is generally sufficient to stop their ravages.

There are several more insects attacking the apple, but the ones given are the most important.

INSECTS ATTACKING THE PEAR TREE.

"SUCKING INSECTS."

I. * THE PEAR LEAF BLISTER MITE. *Eriophyes pyri*. ORDER PHYTOPTIDÆ.

This pest is found all over England now, and is on the increase.

It has also been found out that trees near badly infested trees need not be, and are not, themselves attacked. It is said to attack the apple and several other rosaceous plants. It is easily recognized, as the mite-infested pear leaves show raised patches or blisters with a minute opening on the under side. These blisters are red or green, later becoming brown. The mite is very minute, being about one hundred and thirtieth of an inch long, having a rounded body and elongated form. The anterior end of the thorax has a semicircular shield on its upper surface. There are two pairs of five-jointed legs, each ending in a claw with a four-plumed bristle. The abdomen is transversely ringed. On the upper surface of the mite and springing from the hind edge of the shield are two bristles. The abdomen bears two bristles towards its front end, about the middle are two fairly long bristles,

* This is not a true insect.

near the hind end are two very short bristles, and also there are two long bristles at the tail. The mite is whitish in colour. The larva resembles the mite, the only differences being the smaller size and the weaker bristling.

The mites hibernate in numbers under cover of the outer bud-scales of the buds on the shoots of the year.

In spring the mites gall the young leaves, and the adult females lay their eggs in these galls. New broods of mites come from these galls and spread to other leaves. Before leaf-fall, the mites hibernate in the outer bud-scales.

Insecticides.—Spray in January with lime-sulphur wash, made with 20 lb. of quicklime, 36 lb. of flowers of sulphur, 80 gall. of water.

The lime is slaked, and whilst still hot the sulphur is added, and the whole covered with canvas in a wooden vessel and allowed to boil for twenty minutes, stirring occasionally. Then the rest of the water is added, and the mixture is diluted, using one gallon of the mixture to twelve gallons of water.

This winter wash also kills fungi.

“BITING INSECTS.”

I. THE PEAR SAWFLY, *Eriocampa limacina*. ORDER HYMENOPTERA.

This pest also attacks the cherry, plum, damson, peach, and sometimes the apple, also several forest trees, and species of thorn.

The sawfly is harmless, but the larvæ, known as “slugworms,” eat away the upper epidermis of the leaf and the soft parenchyma between the veins. It is also on the increase, and decidedly checks the crop to be produced.

The sawfly is one quarter of an inch long, with a wing expanse of one half of an inch. Its body is blackish, with dusky wings that have traces of a dark band across them, being paler at the tips, and has dark legs.

The larva, on emerging, is white, but becomes green in a day or two, and soon a dark green slime exudes, and covers the body, protecting it from the attacks of parasites, and from atmospheric conditions. Its head is much broader than the lower part, causing a tapering appearance, and making it look very much like a tadpole. It has seven pairs of sucker-like feet on its abdomen, three pairs of feet upon its thorax, and a pair of sucker-like feet on the end of its body, but with all these feet it moves very slowly. The mature larva is half an inch long, and after five moultings it has an orange-yellow colour, nothing like its sluggy appearance.

The sawflies are seen at the beginning of June, and then the female makes an irregular slit in the leaf by means of its saw-like apparatus, and deposits in this abrasion an egg.

The egg is always laid on the under surface of the leaf, and about twenty eggs are laid on one leaf.

The larva hatches in about ten days, emerging from the upper

surface of the leaf. It eats tremendously, and when mature crawls down the tree, and develops into a pupa in a small cocoon made of silk and soil.

The pupal stage lasts two weeks in the summer, and there are two broods in a year, and the larvæ can be seen on the leaves until October.

Insecticides.—Spray the trees to poison the larva's food with 1 lb. of Paris green to 200 gall. of water.*

Spray also with: 1 oz. of fresh hellebore, 2 oz. of flour, to 3 gall. of water.

This wash must be constantly stirred and the ingredients must not be allowed to settle.

The fruit must not be picked for four weeks after spraying with the above washes, as they are poisonous.

Or inject carbon bisulphide into the soil just before the sawfly is emerging from the pupa.

2. THE PEAR MIDGE, *Diplosis pyrivora*. . ORDER CECIDOMYIDÆ.

Pear-growers a few years ago used to think that the cause of little pears falling was the unhealthy condition of the tree, or adverse atmospheric conditions, but now they know it is often the work of the pear midge.

This insect has been known in this country for twenty-five years, and has perhaps been longer, but there were not many good observers at that time, and the result of the attack was easily explained by atmospheric conditions.

Early-flowering pears are much more liable to its attacks than late-flowering ones, and Williams' Bon Chrétien, with its allied form the Bartlett Pear of America, are the ones most attacked.

It is on the increase, and should be remedied as soon as it is seen.

The fly is about one-tenth of an inch long, with a wing expanse of one-fifth of an inch.

Its body is blackish-grey or black in colour, and covered with pale yellowish and white hairs. The male has very long, dark brown antennæ, with twenty-six joints. Its legs are very long and yellowish-brown, and its wings are grey, with dusky hairs. The female is slightly longer than the male, having an exceedingly large ovipositor for the purpose of depositing her eggs in the blossom's calyces. It has a fourteen-jointed antenna, it is of a dusky grey colour, and is always paler than the male.

The larvæ are yellowish-white in colour, footless, and are composed of fourteen segments, with a brown head bearing two two-jointed antennæ. On the underside, near the head end, is a brown anchor-shaped piece, or the breast-bone. The mature larva is about one-sixth of an inch long.

The pupa is black above and yellowish-brown beneath, and one-tenth of an inch long.

* Use lead arseniate.

The midge appears in April, and is seen until the middle of May. The female lays its eggs, which are long and transparent white, both in the unopened and expanded flowers, by means of its ovipositor. When the blossom is unopened, it pierces the petals and deposits the eggs in little heaps on the anthers, but when the blossom is expanded it pushes its ovipositor deep into the pistil or ovary. In about six days the eggs hatch and the young larvæ make their way into the developing fruit.

The larvæ are mature in early June, and have left the fruit (this, however, depends on the weather), by means of a cleft in the fruit or by some decayed patch. The larvæ generally escape from the fruit when it is still hanging, but not always. The larvæ can skip, characteristic of the Diplosis, by bending their bodies forward, fifteen to twenty generally being seen on a fruit. Springing from the fruit to the ground, they bury themselves two inches below the surface. By the end of two weeks they have made little papery cocoons of a dirty creamy silk, being one-tenth of an inch long. They pupate either a few weeks after entering the soil or in the early spring.

About a fortnight after the attack has started the fruitlets begin to swell abnormally, growing much more rapidly than the sound, on account of the irritation set up by the female's ovipositor.

The fruits, in time, become distorted and contain the larvæ; a fruit thus seen to be distorted should always be cut open to see if there are any larvæ present, because the fruits can become distorted without having been attacked by this pest.

Insecticides.—All infected fruits should be collected and burnt, as they contain the larvæ.

Top dress in late summer with kainit, half a ton to the acre, to prevent the larvæ pupating in the soil.

Inject carbon bisulphide into the soil at the end of March to kill the insects just coming from the pupal stage.

The other insects that attack the pear tree have been mentioned under the heading of "Insects attacking the Apple Tree."

Some of the other insects are :—

- | | |
|--|-------------------|
| 1. Large Tortoiseshell Butterfly, <i>Vanessa poly-</i>
<i>chloros</i> | Order Lepidoptera |
| 2. Mottled Umber Moth, <i>Hybernia defoliaria</i> | " " |
| 3. Common Tortrix Moth, <i>Tortrix ribeana</i> | " " |
| 4. Wood Leopard Moth, <i>Zeuzera aesculi</i> | " " |
| 5. Goat Moth, <i>Cossus ligniperda</i> | " " |
| 6. Gold Tail Moth, <i>Porthesia similis</i> | " " |
| 7. Lappet Moth, <i>Lasiocampa quercifolia</i> | " " |
| 8. Scalloped Hazel Moth, <i>Odontopera bidentata</i> | " " |
| 9. March Moth, <i>Anisopteryx aescularia</i> | " " |
| 10. Green Pug Moth, <i>Chloroclystis rectangulata</i> | " " |
| 11. Pear Thrips, <i>Euthrips pyri</i> | " Thysanoptera |

- | | | |
|---|---|------------------|
| 12. Plum Bark Beetle, <i>Scolytus rugulosus</i> | . | Order Coleoptera |
| 13. Green Leaf Weevil, <i>Phyllobius maculicornis</i> | „ | „ |
| 14. Brown Leaf Weevil, <i>Phyllobius oblongus</i> | . | „ |
| 15. Red-legged Weevil, <i>Otiorhynchus tenebricosus</i> | „ | „ |
| 16. Oblong Leaf Weevil, <i>Phyllobius oblongus</i> . | „ | „ |

These insects can generally be easily dealt with by spraying the tree when the larvæ are seen with 4-6 lb. of lead arseniate to 100 gallons of water, or shaking the trees over tarred paper in the cases of the Coleoptera.

INSECTS ATTACKING THE PLUM TREE.

“SUCKING INSECTS.”

1. THE PLUM APHIS, *Aphis pruni*. ORDER RHYNCHOTA.

This is a leaf-curling aphid, and attacks all kinds of plums, and is known as a bad pest all over England.

The eggs are laid on the trees in winter, and the larvæ emerge from them in early spring, being then of a dark-green colour.

They grow rapidly, and the majority develop into apterous, viviparous females, being of a deep green or brown colour.

They have light-brown antennæ, dark-brown cornicles, and three faint green stripes on the abdomen.

These females produce young, which develop into viviparous females. About June, rudimentary wings are formed, and the pupal stage commences. The pupæ are shiny green in colour, with brown-edged wing cases, and very dark cornicles. About the middle of June the pupal stage is almost over, and from these pupæ you get winged viviparous females, which leave the plum, returning to it in the autumn, when they produce young which in time give rise to winged males and wingless oviparous females, and many more females are produced than males.

In October there can be seen numerous bright, shiny, blackish eggs.

In spring the leaves become quite covered with the aphides and their excreta, and by their puncturing apparatus the leaves curl up, making it very hard for spraying.

Insecticides.—Spraying in spring before the leaves curl up with paraffin emulsion: soft soap 3 lb., paraffin 22 oz., water 9 gallons.

The soap is dissolved in the water, and the paraffin is churned gradually and thoroughly with it, and spray with this only before the leaves have curled, as it would not get to the aphides once they have succeeded in curling the leaf.

2. THE MEALY PLUM APHIS, *Hyalopterus pruni*.

ORDER RHYNCHOTA.

This aphid is different from the last, as it does not curl the leaves, but collects beneath them in dense, mealy masses.

The insect is of a pale-green colour, with a covering of mealy secretion.

The honeydew given off by the insects does the most damage, as it falls from off the leaves on to the fruit, turning it into a sticky, black mass and closing the stomata.

Their life history is very imperfectly understood.

They make their appearance on plum trees in June or July, going away again in early autumn.

Insecticides.—Spray in June or July with soft soap 2½ lb., paraffin 18 oz., water 9½ gall., and add to every 100 gall. of this above wash 1 lb. of potassium sulphide.

“BITING INSECTS.”

I. THE PLUM BARK BEETLE, *Scolytus rugulosus*.

ORDER COLEOPTERA.

This pest is supposed only to attack old, diseased and neglected trees.

It also attacks the apple, pear, cherry, and peach.

The beetles are seen in April and May, and the female commences to bore holes in the bark of the tree, and form “mother galleries,” and upon these sides she deposits her eggs.

The larvæ emerge in a few days, and are whitish in colour, legless, and one-tenth of an inch long, and lie in a curved position. Their heads are yellowish or cream-coloured, and soon commence to feed on the inner bark of the tree, forming “larval galleries” at right angles to the “mother galleries.”

At the end of these secondary galleries small cavities are made, in which pupation takes place.

The larvæ often eat their way into the solid wood.

Early in July the beetles hatch out and bore their way through the bark and escape; and this generation reproduces itself, and the larvæ hibernate in the tree.

The male seems to be quite rare and is seldom found.

Remedies.—Cut off all old and infested branches and burn them in June.

Old, worthless trees, and badly infested trees, should be cut down and burnt in June.

Their natural enemies are the woodpeckers, that will strip the bark off trees to get to the pupæ.

2. THE RED-LEGGED WEEVIL, *Otiorhynchus tenebricosus*.

ORDER COLEOPTERA.

This pest is very destructive, and also attacks the apricot, cherry, nectarine, peach, raspberry, loganberry, and strawberry.

The weevil varies in size from two-fifths of an inch to one half an inch long.

It is black in colour and shiny, with dull red legs, and the wing-cases bear lines of punctures, and in fresh specimens some ashy-grey scales.

The new-laid eggs are white, but in a few days become quite black.

The larvæ are legless and hairy, and of a creamish colour.

The pupa is pale and brownish white.

The female deposits her eggs just beneath the soil in August.

The larvæ hatch out in seven to ten days, and at once enter the soil and feed upon various roots, and preferably strawberry roots.

Pupation takes place in the spring, the pupa being found in an earthen cell about two inches below the soil level, where it remains from fourteen to twenty days.

There are two broods in one year.

Remedies.—Pour boiling water all round the tree in September and onwards to kill the larvæ ; or inject naphthalene into the soil for the same purpose.

3. THE RED PLUM MAGGOT, *Opadina funebrana*. ORDER LEPIDOPTERA.

This is a very common pest of plums, and, as the larvæ live within the fruits which do not fall off the trees, they are often seen in bottled fruits.

The moths are seen in June and July, when the female deposits her eggs on the developing fruit at the stalk base.

The larvæ emerge in ten days, and at once eat their way into the fruit. They are reddish-brown in colour, with yellow sides, and the eighth, ninth, eleventh, and thirteenth segments have each two dark lateral spots. Each segment has three pairs of lateral hairs, except the last, which has a number of small hairs. The adult larva is half an inch long.

On entering the fruit, they eat a tunnel through the fleshy portion until they come to the stone, when they gradually form a larger cavity.

When full fed they leave the fruit, and spin silky white cocoons under the bark or under rubbish on the ground, in which they hibernate, and pupate in the spring.

Insecticides.—All fallen, grub-eaten fruits should be burnt ; shake the trees to make all infested fruit drop, and then collect it and burn it.

Winter wash with caustic washes to remove all hiding-places for the larvæ.

4. THE PLUM-LEAF SAWFLY, *Cladius padi*. ORDER HYMENOPTERA.

It is a very common pest in plum orchards, but does not do much damage.

It also attacks the cherry, bullace, pear, bramble, rose, &c.

At first sight the attack resembles that of the pear and cherry sawfly, but these larvæ eat the lower epidermis and mesophyll, and leave the upper epidermis alone.

Later on the larvæ eat out large holes in the leaves, which shrivel up.

The flies appear in May and June, when the female deposits her eggs on the underside of the leaves.

The larvæ emerge in ten days, and at once commence to feed upon the epidermis of the underside of the leaf. The young larvæ are of a

light, dirty green colour, with white sides. The larvæ are adult in a month, when they fall to the ground, then they make their way into the soil and form cocoons, within which they remain for another ten days. Then they pupate, and in a few days a second brood appears.

From these latter a third brood may appear, and the larvæ of the last brood remain within their silken cocoons until the following May.

Insecticides.—Spray when the larvæ are seen with 4 lb. of lead arseniate to 100 gall. of water.

Spread tarred paper beneath the trees, and shake them, and burn all the insects that fall on to the paper, they being the larvæ.

5. THE PLUM SAWFLY, *Hoplocampa fulvicornis*.

ORDER HYMENOPTERA.

The pest attacks all varieties of plums.

The fly appears in April or May, when the female punctures the blossom, and deposits in it a single egg.

This hatches in about a fortnight, and the young larva at once commences to make its way into the developing fruit. After feeding for a time on one fruit, the larva passes to another. The inside of the fruitlets becomes quite destroyed, but in the larger fruit only a space is eaten round the kernel. The larvæ are full fed in early July, when they leave the fruit and form in the soil brownish oval cocoons, in which they remain until the following February, when they pupate. There is only a single brood in a year.

Pick and burn all infested fruit.

On a large area, treat the soil beneath the trees with ground unslaked lime, and then turn the soil over.

These are the more important pests attacking the plum tree, others being:—

1. Gold Tail Moth, <i>Porthesia similis</i>	. . .	Order Lepidoptera
2. Common Vapourer Moth, <i>Orgyia antiqua</i>	. . .	„ „
3. Lappet Moth, <i>Lasiocampa quercifolia</i>	. . .	„ „
4. Scalloped Hazel Moth, <i>Odontopera bidentata</i>	. . .	„ „
5. Mottled Umber Moth, <i>Hybernia defoliaria</i>	. . .	„ „
6. March Moth, <i>Anisopteryx aescularia</i>	. . .	„ „
7. Figure of Eight Moth, <i>Diloba coeruleocephala</i>	. . .	„ „
8. Dot Moth, <i>Mamestra persicariae</i>	. . .	„ „
9. Cherry-tree Stem Borer, <i>Semasia woerberiana</i>	. . .	„ „
10. Brown Soft Scale, <i>Lecanium capraea</i>	. . .	„ Rhynchota
11. Brown Currant Scale, <i>Lecanium persicae</i>	. . .	„ „
12. Oyster-shell Bark Louse, <i>Aspidiotus ostreae-</i> <i>formis</i>	. . . . .	„ „
13. Pear Thrips, <i>Euthrips pyri</i>	. . . . .	„ Thysanoptera

All these can be remedied by spraying with 4-6 lb. of lead arseniate to 100 gall. of water, and by shaking the trees over tarred paper for the beetles.

INSECTS ATTACKING THE CHERRY TREE.

"SUCKING INSECTS."

I. THE CHERRY BLACK FLY, *Myzus cerasi*. ORDER RHYNCHOTA.

It is a very bad pest of the cherry and all the varieties, and is especially bad on wall fruit.

It destroys the leaves, and sometimes kills the young shoots.

In early spring, wingless viviparous females appear on the lower leaves, having hatched from eggs laid the previous autumn.

They soon produce live young, which develop into wingless, viviparous females, which soon spread over the tree, feeding on the leaves from their undersides.

The infested leaves, through their punctures, curl up, and many die in the hot, dry weather.

In July most of the aphides develop into olive-green pupæ with yellowish wing-cases.

Later these develop into winged, viviparous females, and for a little time they remain on the tree, and then suddenly leave it.

Where they emigrate to is uncertain, but when they return they give rise to the oviparous forms, the female of which is wingless, and deposits from one to four eggs on the lower branches, trunk, or suckers.

Insecticides.—Spray in spring and autumn with 4 lb. of strong, denatured tobacco to 10 gall. of water.

Spray with caustic winter wash to keep the tree clean, and to prevent any shelters for the eggs.

Remove and burn all suckers that come up.

"BITING INSECTS."

I. THE CHERRY-TREE STEM BORER, *Semasia woerberiana*.
ORDER LEPIDOPTERA.

This pest is destructive and is increasing, and it also attacks the apple, plum, peach, nectarine, and almond.

It bores through the bark into the sapwood. These borings may be very small, but large cavities are formed in badly attacked trees, being two to four inches deep and the same width, extending about one to three feet in length.

Trees thus infested are often attacked by fungi, the lower part of the stem quickly rotting and dying.

The first brood moths appear in May and June, when the female deposits her eggs in crevices in the bark, usually near the ground.

The larvæ emerge in a week, and at once commence to feed on the bark, boring beneath it and forming irregular cavities by eating the inner bark and sapwood, and often penetrating four inches. Their presence can be easily recognized by the sawdust around the hole they have excavated. Exudations of gum are also seen on the tree, and fungi often attack the exposed parts of the stem and roots. The larvæ

are full fed about the end of August, and pupate in the walls of the cavities. The adult larva is half an inch long and of a flesh-coloured appearance.

The moths emerge in a fortnight after pupation, and just when the moth is ready to pupate, the pupa pushes its way through the bark.

The pupa, enclosed in a cocoon, is dark brown in colour.

The eggs from this brood are laid in September, and the larvæ live beneath the bark until the following spring.

They continue to eat until late October, and commence again in March or April.

Insecticides.—Smear the trunks in June and November to a height of three feet with one part of powdered naphthalene to three parts of clay with enough water to make a paste; this smothers and kills the larvæ in their tunnels.

These, with the pear and cherry sawfly, which has been explained under "Insects attacking the Pear Tree," are the most important pests, others being:—

- | | |
|--|-------------------|
| 1. Wood Leopard Moth, <i>Zeuzera pyrina</i> | Order Lepidoptera |
| 2. Gold Tail Moth, <i>Porthesia similis</i> | " " |
| 3. Scalloped Hazel Moth, <i>Odontopera bidentata</i> | " " |
| 4. Mottled Umber Moth, <i>Hybernia defoliaria</i> | " " |
| 5. Green Pug Moth, <i>Chloroclystis rectangulata</i> | " " |
| 6. Cherry Fruit Moth, <i>Argyresthia nitidella</i> | " " |
| 7. Plum-leaf Sawfly, <i>Cladius padi</i> | " Hymenoptera |
| 8. Red-legged Garden Weevil, <i>Otiornychus tenebricosus</i> | " Coleoptera |
| 9. Plum Bark Beetle, <i>Scolytus rugulosus</i> | " " |

All these can be remedied by spraying when the larvæ are seen with 4-6 lb. of lead arseniate to 100 gall. of water, and in the case of the beetles shake the trees over tarred paper to catch them.

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