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*THE
ENEMIES
of the
ROSE.*

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The National Rose Society's Handbook on
the Fungoid and Insect Pests of the Rose,

ENTITLED—

THE ENEMIES OF THE ROSE

BY

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AND

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Wye, Kent.*

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Edited by the Hon. Secretary, under the direction of the
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❧ PREFACE. ❧

THIS little work will, no doubt, be warmly welcomed by our Members, for it not only gives the life history of the different fungoid and insect pests which attack the Rose, but also instructions as to how they may be kept in check, and destroyed.

The excellent illustrations by Miss BEARD will also help them to identify nearly all the enemies with which their Roses may be at any time attacked.

Beginners, and those having little knowledge of Rose-growing, will in the first instance do well to consult the Introduction, in which an endeavour has been made to show how comparatively easy it is to keep in subjection the three most common enemies the Rose grower has to contend with.

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INTRODUCTION.

THE inexperienced Rose lover need not be alarmed at the large list of enemies described in the following pages, for after all only in exceptional cases is he likely to be seriously troubled by any but the following:—

1. **Grubs and Caterpillars.**—With the advent of the new leaves on his Rose plants in the spring will come all sorts of caterpillars and grubs ready to destroy the foliage, and to find their way to the flower buds as soon as formed. These must be sought for on their first appearance, and wherever a leaf is found curled up it must be picked off, and the grub or caterpillar concealed in it crushed between the finger and thumb while still young.

2. **Greenfly or Rose Aphis.**—Those green and brown little creatures called greenfly may be seen on the leaves of Roses, and more particularly at the tips of the shoots, at almost any season of the year. If taken in time, that is when they are few in number, they can be kept in check by the frequent and skilful use of the thumb and finger. If allowed to increase they will rapidly multiply, and they must then be dealt with in some other way. The plants may be either sharply syringed with plain water, or syringed with any of the many insecticides sold for the purpose. Care must, however, be taken that the preparation is never applied stronger than the directions printed on the bottle.

3. **Mildew.**—This will be found the worst of the three enemies of the Rose here dealt with, and the most difficult to overcome. It appears as a white mould on the foliage of Rose plants, and if not promptly checked will spread from one plant to another over the whole collection. There are few, if any, gardens entirely free from this disease, although in some it is much more troublesome and persistent than in others, and more particularly in the autumn. By those who may not have the means of spraying the plants with the preparations mentioned on page 22, it may be kept in check with flowers of sulphur. The simplest way to apply this remedy is to lightly dust the sulphur over the whole of the affected plants, by means of a fine muslin bag, on the first calm evening after it is detected, and to repeat the dusting at intervals as may be found necessary until the mildew has disappeared.

There are two golden rules which should be kept in mind when waging war against the above insect and fungoid pests. The first is to look out for them early, and on their first appearance to at once take the necessary means for their destruction. The second is to persevere with the remedy adopted until a cure has been effected.

In order to give the beginner confidence, I may add that by following the foregoing instructions, and keeping strictly to the two golden rules I have here laid down, I have for many years kept my own collection of over two thousand Rose Plants free from all fungoid and insect pests throughout the year. Had I only had the assistance of this little book and adopted the preventive

measures recommended in it, my contests with the enemies of the Rose would, no doubt, have been considerably lightened. For, as Mr. Massee reminds us, "prevention is better than cure."

It should not, however, be long before the tyro in Rose Culture will be in a position to appreciate and take advantage of the more scientific methods described in the following pages for the prevention and destruction of the foregoing and other pests that the Rose is heir to. But, as regards the insect pests of Roses, Mr. Theobald truly says, "the remedies which one can apply are few and simple. They may be summed up as 'just a little gentle washing with non-caustic substances, and a lot of finger and thumb work.'"

THE EDITOR.

NOTE.—Members who find any difficulty in carrying out the directions given in this little manual, or who meet with any insect or other pest attacking their Roses, which they are unable to distinguish, and are consequently at a loss to know how to deal with it, are invited to apply to the Hon. Secretary of the Society, who will endeavour to obtain for them the information they require.

ROSE MILDEW
(page 19).

DISEASES CAUSED BY FUNGI.

BY GEORGE MASSEE, V.M.H., F.L.S.,

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GENERAL REMARKS.

“Prevention is better than cure” should be borne in mind in all attempts to check diseases caused by fungi. 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 severely injuring the plant. As a rule the appearance of mildew or other fungus on a plant is considered as evidence of the primary attack of the parasite. The statement that plants that were healthy yesterday are suffering from disease to-day is frequently made, nevertheless it is a mistaken idea. 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 materials accumulated by the plant for its own use. This process of growth on the part of the spawn extends over a variable period of time, depending on the particular kind of fungus, but usually lasts from one to two weeks, before the leaf shows any signs of the presence of the parasite. When the spawn has accumulated a sufficient amount of reserve food its presence is indicated by a yellow or brown patch on the surface of the leaf, and at a later period the fruit of the fungus bursts through to the surface, when the spores

are quickly conveyed by wind, rain, birds, insects, &c., to neighbouring plants, and, unless drastic measures are resorted to, an epidemic is the result. It is not necessary to dilate on the difficulty experienced in checking an epidemic of mildew.

From the above brief account it may be gathered that infection has taken place, some time before its presence is revealed under the familiar form of mildew or rust, and it is obvious that the prevention of infection is the point to be aimed at.

To effect this object two conditions are absolutely necessary, viz., cleanliness and spraying.

The cleanliness necessary is of a special nature. The spawn or mycelium of many kinds of parasitic fungi are perennial in the tissues of the plant attacked ; in other words, when a plant is once infected the mycelium remains in a living condition in the plant from one year to another, and each season the disease shows itself without any further infection from without. This, however, is not the case with mildew, rust, and black spot, the three most destructive and frequent of diseases to which Roses are subject. During the winter a given Rose tree, however seriously it may have been attacked by either or all of the diseases named during the summer, is perfectly free from disease, and will remain so unless a new infection takes place. In the case of mildew, infection is due to the winter spores that are produced on the patches of white cottony mildew growing on the *shoots*. The special cleanliness in this instance consists in carefully removing every trace of white felted mildew from the shoots and stem.

In the case of rust and black spot, the winter spores, or those spores that start the disease the following season, are produced on the *leaves*. Those infected leaves mostly fall to the ground in due course, and many such are blown into nooks and crannies, where they remain until the following spring, when the winter spores they bear produce other still smaller spores, which are dispersed by wind, &c., and renew the disease. The remedy consists in collecting and burning all fallen leaves, also those that remain on infected bushes.

Notwithstanding all possible precautions being taken on the lines indicated, you may rest assured that some winter spores have escaped detection, or have been transported by wind, birds, &c., from some neighbours' garden where no preventive measures have been exercised; or, finally, from wild Roses growing in the neighbourhood.

To meet this probability, or better say certainty, spraying is absolutely necessary. It is important to grasp the fact that spraying is purely preventive in its action. No disease can be cured by spraying! If a mildewed Rose tree is sprayed the leaves that are already diseased are not cured, but the disease may sometimes be prevented from extending, owing to the substance deposited on the leaves acting as a poison, and killing those spores that alight on the leaves, which would otherwise set up a new point of infection. From the above account it will be seen that spraying is of value in proportion to the time the substance sprayed remains on the plant. Unfortunately the most effective spraying solution, and the one that remains for the longest period

of time on the foliage, that is Bordeaux mixture, cannot be used on Rose bushes in gardens, &c., as it imparts a whitewashed appearance to the plants. Those solutions that can be used without imparting an unsightly appearance to the plants will be given in the proper place.

Certain periods of time between successive sprayings will be indicated, such periods, however, as will be readily understood, can only be suggestive. All spray solutions are washed off foliage by rain, consequently if you spray on a given day, and a sharp shower follows the operation, you must necessarily spray again at once, although it may be stated that spraying every fourth day is sufficient. The statement only means that spraying at intervals of four days will prove effective, on the understanding that the solution is not removed from the foliage by rain or heavy dew.

In like manner the amount of material to be used in the preparation of a spraying solution will be given. This, again, can only be relative. Scorching of the foliage invariably follows the use of too strong a solution. This depends on the relative "hardness" of the foliage. The same solution that acts properly on a plant growing in the open will scorch the foliage of a plant growing in a damp shady place. Commence spraying with a solution diluted with more water than is indicated in the formula given, and increase the strength as experience dictates.

I am afraid that the above reading may be considered somewhat dogmatic, but experience has proved that it is necessary.

ROSE RUST OR ORANGE FUNGUS

I. THE WINTER SPORES
(page 24).

2. THE SUMMER SPORES
(page 24).

Finally, spray in anticipation of disease, and do not delay until too late. If a speck of mildew appears on a leaf it is certain sign that a fungus spore had fallen on the leaf previously, had germinated there and penetrated the tissues. Now if that particular leaf had been sprayed the spore that alighted on its surface would have been killed, and no injury would have followed. Therefore anticipate the advent of mildew which is certain to appear. The vain endeavour to arrest an epidemic is disheartening, the means of checking its appearance are simple and certain.

Fungi are so very different in their mode of growth from that of any other group of plants that some knowledge of their peculiarities is necessary to prevent loss of time and expenditure of energy in wrong directions in attempting their destruction.

The majority of parasitic fungi produce two or more totally different kinds of fruit, each of which serves a special purpose. Taking Rose mildew as an example, the familiar whitish patches that appear on young Rose leaves early in the season, consist of mycelium or spawn that bears myriads of exceedingly minute spores. These spores are produced in rapid succession throughout the summer months, and are capable of germinating and infecting a plant the moment they are ripe. Such are called summer spores, and their use to the fungus is to enable it to spread quickly and extend its range of distribution, hence epidemics of disease are invariably due to summer spores, which retain their vitality only for a few days.

As the season advances and the host plant becomes less active in supplying the amount of food required by the fungus, summer spores cease to be produced, and in their place winter spores are formed. Winter spores differ as much in structure and general appearance from summer spores as a pea does from a turnip. Their use to the fungus is also totally different. They will not germinate until after a considerable period of rest, in fact not until the spring following their production. In the spring, when Rose leaves appear, the winter spores present on the patches of white mycelium that grew on Rose stems the previous season, escape into the air, and those that happen to alight on young Rose leaves set up infection, which results in the production of that form of the fungus which bears summer spores.

From the above brief account of the mode of life of Rose mildew, it is obvious that two special methods of treatment are necessary to successfully combat this pest.

(1) Spraying as soon as the leaf buds expand to prevent infection by the winter spores.

(2) In spite of spraying, a certain amount of mildew will probably establish itself, more especially on the young growth. To prevent this from setting up infection the following season, all winter spores present on the new wood should be removed. Details on this point will be given later.

(3) All bushes that have been attacked by any kind of fungus whatever should be thoroughly drenched with

a solution of sulphate of copper—one ounce in two gallons of water. The surrounding soil should also be similarly treated.

It is very important to remember that this wash should be applied during mid-winter, before the leaf-buds begin to swell in the least, otherwise the foliage will be destroyed.

ROSE MILDEW (*Sphærotheca pannosa*).

This is undoubtedly the most destructive and, at the same time, the most prevalent disease with which the grower of Roses has to contend. Like most other parasitic fungi it is sporadic in its appearance; during certain seasons it assumes the proportions of an epidemic, whereas on other occasions it does but little injury, but it is never entirely absent. The waves of serious disease are mainly due to neglect in not fighting the pest when present in the smallest quantity, which means that it is struggling against difficulties, and could much more easily be overcome.

The reason why mildew is so much more prevalent during some seasons than others depends almost entirely on the host-plant, and not on the fungus, which is always present in sufficient quantity to set up an epidemic if conditions are favourable. Broadly speaking, "soft" foliage favours the disease, whereas "hard" foliage cannot be so readily infected. This statement is not only true so far as relates to foliage affected by weather conditions, but also as to the relatively hard or soft foliage and shoots of different kinds of Roses. The microscopic structure of the leaf of the "Crimson

Rambler" indicates that it could readily be infected, and this proves to be the case with this variety. The greater susceptibility of Roses, and of plants in general, to disease when grown under glass, than when the same kind of plant is grown in the open, depends almost entirely on the relative "softness" of the foliage and shoots. Early morning ventilation, which is too frequently neglected, is the best corrective for this condition of things.

A damp, warm "muggy season" causes the foliage of plants growing in the open to remain "soft," and highly susceptible to disease. The reason of this is the roots are constantly taking up water which cannot readily escape from the leaves on account of the amount of moisture present in the air, consequently the cells of the leaf are always distended with watery cell-sap, a condition of things which favours, in the first instance, the rapid germination of fungus spores that alight on the surface of the leaves, and secondly, the easy entrance of the germ-tubes of such spores into the interior of the leaves.

An exceptionally rainy season is unfavourable for the development of mildew and other fungus diseases, because rain washes the spores to the ground almost as fast as they are produced, also those spores that do alight on the leaves are frequently washed off before they have time to germinate and enter the tissues of the leaf. Another factor of importance is the comparative absence of insects which play an important part in conveying spores of fungi from infected to healthy bushes.

Mildew is present throughout the season every year in greater or less abundance, but as a rule there are two

BLACK SPOT
(page 25).

marked waves of disease ; one in the spring soon after the foliage is full grown. The second wave appears soon after midsummer, and attacks the leaves and shoots of the new growth (see Plate I.).

During an average season the spring wave of disease is usually of a mild character, and apt to be overlooked, or, at all events, neglected. This neglect, however, may lead to serious results, for the scattered patches of mildew furnish the spores that infect the flower buds and at a later stage set up the second wave of disease, which is mostly confined to the new growth.

The white summer fruit is alone produced during the first wave of infection in the spring, as the wood of the previous season cannot be infected, and the winter fruit is only produced on the mildew growing on the shoots. For this reason the late summer wave of infection is most dangerous, inasmuch as it furnishes the fungus fruit that starts the disease the following season. As previously stated, the winter fruit appears on the white cottony tufts of mycelium growing on the young wood, rarely on the fruit, never on the leaves.

PREVENTIVE MEASURES.

(1). *Cleanliness*.—As will have been gathered from the preceding account, the extension of mildew depends on summer spores produced on the leaves being conveyed by wind and other agents to other healthy leaves. This risk is met by spraying, which will be dealt with in the next paragraph ; on the other hand, the appearance of mildew during the following season depends entirely

on the presence of winter spores that are formed on the white patches of mycelium growing on the wood, and sometimes also on the fruit. It is therefore of the utmost importance that every patch of mycelium present on the wood and fruit should be carefully scraped off and burned. This work should be done as early in the season as possible, otherwise some of the winter spores may fall to the ground, where they will survive the winter and possibly prove a nuisance the following spring.

(2). *Spraying*.—As the result of personal experience, supported by the testimony of others who have experimented under my direction, I strongly recommend as a spraying solution one part of commercial sulphuric acid diluted with one thousand parts of water. This solution, consisting mainly of water, does not adhere to the foliage for any length of time, and constant spraying is necessary if the disease appears. In such cases I find that if bushes showing incipient stages of disease are sprayed for three days in succession, the disease is entirely checked, but it is always wise to spray, say once a week in anticipation. I have used a stronger solution later in the season without in any way injuring the foliage, up to one part of acid in seven hundred parts water. As previously stated, different strengths must be carefully tested, but there is no advantage in using a very strong solution under any circumstances.

The finer the spray the better it adheres to the foliage. If the spray is too coarse the particles run together to form drops large enough to run off the foliage. The same result follows spraying too much liquid on to a bush.

After using the sulphuric acid solution, a small amount of pure water should be pumped through the sprayer. If this precaution is not neglected no injury is caused to the metal by the acid.

The acid solution should be mixed in a wooden vessel.

A solution of potassium sulphide or liver of sulphur—half an ounce dissolved in a gallon of water, is also a good fungicide. If a tablespoon full of liquid glue is mixed with each gallon of the solution it adheres much longer to the foliage. If the whites of two eggs are used instead of the glue, the adhesiveness is still greater. If the foliage is not very tender two ounces of the sulphide may be dissolved in three gallons of water.

Potassium sulphide acts in the same manner on the fungus as flowers of sulphur does when dredged over the foliage, but its action is quicker, and if the spraying is judiciously carried out the foliage is more uniformly covered.

It may be mentioned that the potassium sulphide solution discolours paint.

Mr. Mawley informs me that out of the many remedies he has tried, a preparation called "Mo-Effic" has proved to be the most successful in combating mildew.

ROSE RUST (*Phragmidium subcorticatum*).

During certain seasons this pest proves very troublesome, and is partial to hardy hybrid varieties, but no variety has proved to be immune. It is abundant on

our wild Roses, and may frequently be found on shoots growing from stocks of standard Roses in neglected gardens.

Three different kinds of fruit are produced, two kinds of summer spores, æcidiospores and uredospores respectively; these follow each other in the order named, and appear under the form of deep orange, powdery patches on the leaves and wood. The patches on the leaves are usually small, but when several are present they frequently grow into each other, and then frequently cover the greater portion of the surface of the leaf (see Plate II., Fig 2).

On the wood the patches of rust are often large, extending to one inch in length, and often cause distortion or curving of the part affected. When the rust disappears gaping wounds or canker spots remain, which favour the growth of other kinds of fungi.

During the autumn the winter form of fruit appears on the under surface of the fading leaves, under the form of minute black, projecting points, which are usually uniformly scattered over the entire surface of the leaf. These black points consist of clusters of winter spores, which remain on the dead, fallen leaves in a resting condition until the following spring, when they commence growth afresh and produce exceedingly minute spores, technically known as secondary spores. These secondary spores infect the young leaves and wood, and give origin to the orange summer form of the fungus (see Plate II., Fig. 1).

PREVENTIVE MEASURES.

To prevent a recurrence of this disease it is imperative that all leaves bearing winter spores should be collected and burned. This applies equally to fallen,

ROSE LEAF-SCORCH

(page 26).

dead leaves, and to leaves remaining on bushes that have been infected. If this work is thoroughly done no infection can take place the following season. Winter spores are not formed on the wood.

In cases where rust has previously existed, the bushes should be sprayed just when the leaves are expanding, with a solution of potassium sulphide. If rust spots appear on the wood the patches should be treated with a solution consisting of equal parts of methylated spirit and water. This may be thoroughly rubbed in with a piece of sponge.

As previously stated, rust is very common on wild Roses, and if such exist near to a Rose garden preventive spraying should be carried out in the spring, as the spores are liable to be carried from one place to another by wind, insects, birds, &c.

BLACK SPOT (*Actinonema rosae*).

This disease is confined to the foliage, and as a rule is not much in evidence before mid-summer. It appears under the form of somewhat large black or purplish spots, but varies in appearance depending on the texture of the leaf on which it is growing. The patches are sometimes almost circular in outline, and reach to one quarter of an inch in diameter; at other times the outline is very irregular, giving the leaf a marbled appearance. The blotches are most distinct on the upper surface of the leaf. Although the patches appear black to the naked eye, if examined with a magnifying glass a very delicate, white, cobweb-like mycelium will be seen covering the patches and radiating towards the margin (see Plate III.). When the leaves are fading the surface of the patches are studded with minute black warts, the fruit of the fungus.

In addition to the unsightliness caused by this fungus, it is very injurious; the mycelium permeates the entire structure of the leaf, causing premature defoliation. This causes the upper buds to expand before their time.

PREVENTIVE MEASURES.

Badly diseased leaves should be removed, as spraying appears to produce but little effect in checking the disease when it has once gained a foothold, as all infection is nearly simultaneous and not progressing throughout the summer, as is the case with mildew and rust. All diseased leaves lying on the ground, also those remaining on the bushes, should be collected and burned.

Where the disease has existed spraying with potassium sulphide or other fungicide should be commenced in the spring, and continued at intervals.

ROSE LEAF-SCORCH (*Septoria rosæ*).

This disease is often neglected or considered as of secondary importance; nevertheless, when it occurs under the form of an epidemic it is often very injurious, more especially to nursery stock, which, when attacked for two seasons in succession, rarely completely recovers. The injury caused by the disease is due to the premature defoliation it produces, diseased plants being often quite leafless by the end of July. If the remainder of the season is favourable a second crop of leaves is produced, which leads to exhaustion, imperfectly matured wood, &c.

The fungus is confined to the leaves, and its presence is first indicated by the appearance of minute yellowish-green patches scattered over the surface of the

leaf. These spots for some time continue to increase in size, and gradually change to a pale brown colour and are bounded by a dark line. If the leaf is attacked before it is full grown the brown patches usually fall out leaving holes in the leaf. In other instances the dead patches remain fixed, and if a dead diseased leaf is examined during the winter with a magnifying glass, the brown patches will be seen to be studded with very minute black points, which are the reproductive bodies of the fungus. The small dead pieces that fall away also produce fruit during the winter when lying on the ground (see Plate IV.).

PREVENTIVE MEASURES.

This is a very difficult fungus to eradicate, owing to the particles of diseased leaves bearing the fungus falling away and being blown far and wide by the wind, also on account of the extreme prevalence of the disease on wild Roses and brambles.

Where the disease has existed the bushes and also the surrounding ground should be thoroughly drenched with the sulphate of copper solution recommended for winter use. In the spring spray with liver of sulphur, commencing when the leaves are half grown, and repeat as required.

All diseased leaves, whether on the ground or remaining on the bushes, should be collected and burned.

SOOTY MOULD (*Fumago sp.*)

Not infrequently the leaves of Roses and many other kinds of plants, both cultivated and wild, become more or less covered with a black, sooty layer, which can be peeled off in flakes during dry weather.

This black layer consists in reality of a dense network of the mycelium of a fungus. The fungus, however, is not a parasite, and consequently does not extract anything from the leaf it is upon, but subsists entirely upon "honey dew" deposited by aphides or "green fly," hence, if the latter are kept in check, you will not be troubled with sooty mould.

INSECT ENEMIES.

BY FRED V. THEOBALD, M.A.,

Vice-Principal and Zoologist of the Agricultural College, Wye, Kent.

GENERAL REMARKS.

There are so many insects which the Rose grower finds on his plants that it is quite impossible to refer to them all in this small manual. Some of the worst kinds only which have been complained of or observed as being harmful are briefly dealt with. Probably these constitute the majority of insects, which we may term "pests."

One readily notices the leaves or buds of a Rose being eaten by a caterpillar, whereas in most other vegetation one pays no attention to such damage unless it be very serious.

The remedies which one can apply for the insect pests of Roses are few and simple. They may be summed up as "just a little gentle washing with non-caustic substances and just a lot of finger and thumb work."

One point we may draw attention to, and that is that we must be careful not to introduce pests into our gardens on briars. We must also look out for young insects, and try and get rid of them before they do any damage.

Late autumnal attacks of insects are often disregarded, but we should bear in mind that the leaves are essential until the wood has ripened, and it may often be necessary to cope with such pests as the leaf-eating sawflies, and some caterpillars in the autumn.

BEETLES (*Coleoptera*) **INJURIOUS TO ROSES.**

Three kinds of beetles only are complained of as enemies to Roses, namely, the Rose Beetle, the Cockchafers and the Weevils. The latter are of little importance as far as we know in Britain.

The Rose Beetle (*Cetonia aurata*).

This beautiful beetle is frequently found in the blossoms and when present in numbers does a good deal of harm. Its distribution is very wide in Britain, but it becomes rarer as we proceed northwards. The beetles are also called Green Rose Chafers. They are harmful to many other plants besides Roses. Damage is done by both adults and their grubs or larvæ. The former eat the petals of Roses and the foliage, the latter the delicate and even thick roots. The brilliant shiny coppery green beetles have a few pale creamy marks on the wing cases (Plate V., Fig. 1). They fly readily in bright sunshine, but in dull, damp and cold weather they are very sluggish and are then found nestling in the Rose blossoms. The anthers of flowers are mostly attacked, but also the petals and even the Rose leaves.

LIFE HISTORY AND HABITS.

The beetles appear in the middle of May and continue on through June. They deposit their eggs in the ground, especially choosing rich, light soil. The eggs hatch into white grubs, swollen at the end, with large brown head and six legs on the first three rings of the body, and are very like the grubs of the Cockchafers, but they have longer legs and a deep reddish-brown spot on each side of the first thoracic segment. The food consists of the roots of various plants besides the Rose.

PLATE V.

1. ROSE BEETLE
(page 30).

2. COCKCHAFER
(page 31).

3. GARDEN CHAFER
(page 32).

4. SUMMER CHAFER
(page 32).

5. CHAFER LARVA or WHITE GRUB
(page 31).

6, 7 & 8. ROSE LEAF-CUTTING BEE (page 33).

When mature their length is about an inch and a half. The full fed state is reached after two or three years in the soil. They then change to pupæ in earthen cells, about an inch long, smooth inside, rough outside. The pupæ are usually found deep in the ground.

The larvæ eat right away at the rootlets and gnaw the skin off the larger roots.

The same treatment is necessary as for Cockchafers (see page 33).

The Cockchafer (*Melolontha vulgaris*).

The Cockchafer, also called the "May-bug," is sometimes harmful to Roses. The adult devours the foliage and sometimes the blossoms and their grubs the roots. These chafer-grubs are frequently spoken of as "White-grubs" (Plate V., Fig. 5).

This beetle is common over a large part of Britain, but a closely allied species takes its place in the north. As everyone knows these chafers appear in large numbers in certain years. This is because they take some time to develop in the grub state in the ground. The presence of these white-grubs at the roots of Roses is very deleterious and may soon kill the tender kinds, we have known both hardy moss Roses and tender kinds killed by them.

The beetle is about one inch in length, its head and thorax black, its wing-cases reddish-brown and hairy, each with four raised lines and at the sides of the abdomen are prominent black and white marks (Plate V., Fig. 2).

These chafers belong to what are called Lamellicorn beetles, because the end of the feelers are composed of several leaf-like plates or lamellæ.

LIFE HISTORY AND HABITS.

The beetle appears in May and June and flies in the evening. The female lays her eggs in the ground, choosing dry soil, and deposits them to a depth of often 8 inches. The ova are creamy white and about the size of a hemp seed. The grubs are creamy white, thick and fleshy, the tail end being swollen into a semi-transparent bladder-like sac, the head is large and horny with strong jaws and there are six jointed legs in front. They lie in a curved position and when mature reach $1\frac{1}{2}$ inches in length. Three years are passed in the soil before they become mature. When full grown they burrow deep into the earth and form an oval chamber, in which they change to the pupal condition. The beetles hatch out some little time before they escape from the soil. Thus we get these chafers appearing every fourth year.

The Summer Chafer (*Rhizotrogus solstitialis*).

The small or summer chafer also attacks Roses. It is much smaller, only being two-thirds of an inch long and of a general reddish-brown colour and slightly hairy (Plate V., Fig. 4). It appears in June and July. The grubs are very similar to the former, but smaller, and can be told by the different sculpturing on their mandibles. The grubs live two years.

The Garden Chafer (*Phyllopertha horticola*).

This is quite a different beetle from both the former and in parts of Britain, notably Wales, is more frequent than either of the preceding on Rose bushes. It varies from a little under to a little over half-an-inch in length. The front part of the body is metallic greenish colour,

and the wing cases are reddish-brown (Plate V., Fig. 3). The male is very hairy. The beetles, unlike the two preceding, are active during the day time. They deposit their eggs as the others do, but the grubs only live a year. This is known as the Coch-y-bonddu in Wales.

PREVENTION AND REMEDIES FOR CHAFERS.

The rootage of Rose bushes should be examined when signs of unhealthiness are noticeable and the grubs picked out by hand. They may be attracted away from the soil by placing grass turves upside down under the earth where the grubs collect and can then be easily picked out and killed. The Large and Summer Chafers may be collected off the bushes in day time. The Garden Chafer is best sought for when the sun is going down and also the Green Rose Chafer, or on dull days. Nothing but hand picking can be resorted to for these adult Lamellicorns.

BEES AND SAWFLIES (*Hymenoptera*) INJURIOUS TO ROSES.

The only hymenopterous insects which are injurious to Roses are the Leaf-cutting Bees, the Sawflies, and to a very small extent Ants. The latter may be excluded as pests as they are mainly found on the Rose bushes when the latter are infested with Green-fly, and they will be mentioned when dealing with those insects.

The Rose Leaf-cutting Bee (*Megachile centuncularis*).

This bee is frequently very annoying to Rose growers, by the frequent incursions it makes on the foliage, not for feeding purposes, but for taking parts of the leaves bodily away. So persistent are they in attacking certain bushes that they cause almost complete defoliation (Plate V., Fig. 6).

Every Rose grower knows the appearance of the leaves shown in (Plate V., Fig. 7). The curious semi-circular cut-out areas of the leaves seen above are the result of the attack of this leaf-cutting bee.

The pieces of leaves are cut out by the bees to form their nests, and for this purpose they use also the leaves of the Annual and Perennial Mercury, but Rose leaves are their favourite. This bee carries the cut-out sections of the leaves to some tunnel it has formed either in decaying wood or in brick walls and now and again in the ground.

These nests are made first by the removal of wood, earth or mortar, until a cylindrical tube is formed, often some inches in length. The female then proceeds to cut pieces out of the Rose leaves to line this tube. She then places an egg at the end and fills it around with a reddish hued substance composed of pollen and honey. This having been done the bee flies off and cuts a circular piece of leaf and shuts in the egg and its attendant food material, several layers of circular leaf substance are added until the cell is firmly sealed up, and so on until six or more cells have been formed (Plate V., Fig. 8).

Upon the stored-up food the white footless maggots coming from the eggs feed and eventually spin cocoons of silk attached to the sides of the cells, and in the coming season, after passing through the pupal stage, the leaf-cutting bees appear again. We can do nothing to prevent them working in this way unless it is by following them to their nests and destroying the same at dusk, when the makers are safely housed within.

The Leaf-rolling Sawfly (*Blennocampa pusilla*).

Very frequently on wild Roses we notice a curious lateral folding over of the leaves. This is due to the larvæ of a sawfly. During the past two years quite a number of instances of this insect attack have been reported upon cultivated Roses. In some cases to such an extent that no blossom was produced. This was especially noticeable in Maréchal Niels. This folding over of the leaves is not only disfiguring but the leaves lose their proper function, and soon shrivel and die.

If one of the folds is opened we find inside one or more green larvæ. This folding of the leaves is mainly accomplished by the larvæ, and as far as I can see it is done by them when immature. Cameron, however, says that they are aided by the incisions made by the females when they lay their eggs. The deformity produced in the leaves varies, but the rolls are always more or less cylindrical. When the leaf dies the larvæ move to another.

In the only cases observed personally it was noticed that the attack was most severe when suckers had been allowed to grow, and the attack had apparently started there. At the same time I have had it reported from Stockport and district, from places in Somerset and Kent, where no such evils were allowed. Both Teas and hybrids have been mentioned as suffering severely.

LIFE-HISTORY AND HABITS.

The sawfly appears in May and June; the colour is black and shiny; the legs, black with whitish knees, tibiæ and tarsi; wings dusky and iridescent. Length

one-sixth of an inch. The eggs are laid on the leaf. The larvæ are all green, with paler areas at the segments and conspicuous hairs on the back; the skin in the later stages becomes somewhat wrinkled, and the head brown and white and shiny. They fall to the ground when full grown and enter the soil in August and at once form a cocoon, in which they remain as larvæ until February or March, when they pupate, and a fresh batch of sawflies comes up and attack the Roses in early summer.

TREATMENT.

Spraying with arsenate of lead would probably be beneficial, but by far the best plan is to hand-pick the folded leaves when first seen and destroy them.

There is little doubt that this insect is introduced into Rose beds with the earth on the roots of briars, in the cocoon form.

It is well therefore to see that all earth is cleaned from the roots before being planted. This may be done by well washing them in plain water.

The Rose Slugworm (*Eriocampa rosæ*).

Another sawfly causes endless annoyance in gardens, namely, the Rose Slugworm, an insect which in its larval stage works very much like the Slugworm or Sneg of the Pear and Cherry.

The larvæ of this sawfly devour the upper epidermis and tissues of the Rose foliage, leaving intact the lower epidermis. The leaves at first become blotched, then almost white, then brown and shrivelled up, the lower skin always remaining intact.

In some years this insect is so very abundant in gardens that it not only causes disfigurement, but materially checks the growth of the bushes.

It is especially common on the hardier varieties, but will attack all kinds. I have seen it work on *Rêve d'or* and on Moss Roses so ravenously that not a leaf remained intact.

LIFE-HISTORY AND HABITS.

The sawfly is much like the former—shiny black, the knees, four anterior tibiæ and tarsi, white and with smoky wings (Plate VI., Fig. 1). Length, one-sixth of an inch. The adults occur first in May, when the females lay their eggs in the mid ribs of the leaves. The larvæ are pale yellowish green, with a darker line down the back, marking the alimentary canal. The head is more or less bright orange. When mature they fall to the ground and pupate in the soil in small oval cocoons.

At least two broods occur during the year. The first larvæ are seen in June, the second brood in August; and in 1907 they occurred in September.

This insect is not only very common in gardens in Britain, but also in France, Germany, Holland, Sweden, Denmark and North America.

TREATMENT AND PREVENTION.

It can easily be killed by spraying the Rose bushes with hellebore wash, which is better than dusting the hellebore powder over them.

If there has been a bad attack it is well to have as much as possible of the surface soil removed in winter, and either deeply buried or burnt and fresh mould put over the roots.

The Rose Emphytus (*Emphytus cinctus*).

The larvæ of this sawfly work in quite a different way, for they eat the leaves entirely away. They start at the edge and eat down to the mid rib. Moreover, they do harm in another way, for when mature they enter the branches and kill the growth above them.

This sawfly is common and widely distributed over Britain as well as on the Continent as far as Eastern Siberia.

LIFE HISTORY AND HABITS.

The adult is black, the thorax with white marks, the abdomen with the fifth segment with a white band, which does not reach all round; legs black, base of femora and apex of tibiæ white, rest of tibiæ and tarsi reddish. The female is one-third of an inch long. The male is smaller and has no white band on the body. This sawfly occurs in June and the female lays her eggs on the underside of the leaves in minute slits. Some seven or eight eggs are placed on each leaf.

The larvæ are found from July to October feeding on the edge of the leaves. The upper part of the body is dark green, the sides pale, the skin is covered with small white spots and is somewhat wrinkled; the head brown yellow and black; legs white, with a dark mark over each of them. The front part of the body is somewhat swollen. They hold on by their front feet to the edge of the leaf and curl the rest of the body in all manner of shapes. When at rest they remain coiled up in a ball on the underside of the leaves (Plate VI., Fig. 2).

On reaching maturity they make their way into the branches and there form a cell in which they pupate in the following spring.

1. ROSE SLUGWORM
(page 36).

2. ROSE EMPHYTUS
(page 38).

3, 4 & 5. VAPOURER MOTH
(page 40).

6, 7 & 8. BUFF-TIP MOTH.
(page 44).

9, 10 & 11. WINTER MOTH.
(page 46).

Treatment, is the same as for the previous species. Other species of sawflies occur on the Rose in Britain, but are not of any importance.*

The chief remedies for sawflies are (1) spraying with hellebore wash or arsenate of lead, and (2) removal of surface soil and dead wood during the winter.

MOTHS (*Lepidoptera*) INJURIOUS TO ROSES.

A large number of caterpillars of moths feed upon the foliage of the Rose. At least twenty may be found fairly commonly on them, but usually only as isolated larvæ, which do not do much damage.

The caterpillars work in three different ways. They eat the foliage (Vapourer Moth, Buff-Tip, etc.) They eat into the unopened blossoms and spin the tender leaves together (Tortrix Moth or Rose Maggot), and they tunnel into the leaves (Rose Gelechia or Miner). After the Green Fly the next worst Rose pest is undoubtedly the Rose Maggot or Tortrix.

The caterpillars of moths can be told by the number of their legs. There are two types found on Roses. The first and commonest, such as the Vapourer, has six jointed legs in front, four pairs of prolegs and an anal pair. The second (as the Winter Moth) has only one pair of prolegs in the middle.

A few only of those moths which are found in their caterpillar stage on the Rose can be mentioned here. Those chosen are generally common and often occur in great numbers, so causing marked damage.

* *Emphytus rufocinctus* and *Poecilosoma candidatum*. The latter appears in April and lays her eggs singly in the point of the young branches. The larvæ eat about $1\frac{1}{2}$ inch into the branch, bore a round hole in the side and fall to the ground to pupate.

The Vapourer Moth (*Orygia antiqua*).

The attack of the beautiful caterpillars of this moth on Roses is well known, not only in the country but also in towns, for the male Vapourer Moth is frequently found in numbers flying about even in the crowded thoroughfares of London and other large cities.

Its distribution is very wide over England and Wales, and it is common in Ireland, especially in the south.

The male moth is winged, of various shades of rich chestnut brown with darker markings on the fore wings and a white moon-shaped mark near the hinder angle; wing expanse over an inch. The female is quite wingless, or at least very small traces of wings are present; she is grey in colour and very plump and reaches about half-an-inch in length (Plate VI., Figs. 3 & 4).

LIFE HISTORY AND HABITS.

The moths appear mainly in August and September, but may continue into October, the males flying in bright sunshine. The females merely crawl from the inside of their cocoons to the outside, where they eventually deposit eggs, often completely covering the silken case. The eggs do not all hatch at once, but come out a few at a time over a period of some weeks.

The caterpillars are variable in size when mature, ranging from $1\frac{1}{2}$ to 2 inches in length. The colour is dark grey, spotted with small red tubercles, four large upstanding tufts of yellow or brownish hairs on the back, and five long tufts of pin-headed hairs of dark colour, two pointing forwards, two lateral and one long one over the tail end (Plate VI., Fig. 5). They mature from

June to August and then spin a cocoon of silk mixed with the hairs from their body, either amongst the leaves and shoots or more usually against a fence, or the trunks of trees. The larvæ then change to deep yellowish-brown pupæ, from which the moths appear in two or more weeks.

Fruit trees and hawthorn hedges, etc., are also attacked by the Vapourer.

TREATMENT.

All the cocoons that are seen in the winter to be covered with eggs should be collected and burnt. If there are only a few caterpillars then they may be hand-picked, but if many it is best to spray the bushes with arsenate of lead.

The Pale Tussock Moth (*Dasychira pudibunda*).

The handsome caterpillar of this moth is called in some districts the Hop Dog. Besides feeding on hops, birch, oak and hazel, it may frequently be found on Roses, where, owing to its ravenous nature, it soon clears off the foliage.

The moth varies in size from $1\frac{3}{4}$ to $2\frac{1}{2}$ inches across the expanded wings. The male is greyish white powdered with dusky scales, with a short dark transverse streak near the base, and a dusky broad band towards the middle; the female is larger than the male, with greyish white front wings and the central band pale grey (Plate VII., Fig. 7).

LIFE HISTORY AND HABITS.

The moth appears in May and June and deposits the eggs on the leaves; the ova are bluish-grey in colour and laid in groups, often as many as 150 in a batch.

They hatch in three or four weeks. The caterpillars are found feeding from August to October. At first they remain in clusters, their heads all turned together; after a week they separate and wander over the bush or to several bushes.

They vary in colour; the commonest form is pale yellowish-green in the young stage, becoming reddish or brown later; there are four dense hairy tufts on the fifth to eighth segments, and between them the colour is deep velvety black, and also after the last tuft; the twelfth segment is provided with a dull red or purplish tail-like tuft, and all the rest of the body is covered with hairs (Plate VII., Fig. 8). One form is all yellow, head and sides green and black marks between the tufts. When mature they reach from $1\frac{1}{4}$ to $1\frac{1}{2}$ inches long; they then spin a slight silken case amongst the leaves, etc., with some hairs in it and change to a dark pupa with two pale bands on the body and little tufts of pale hairs. The winter is passed in the cocoon which may fall to the ground with the leaves, or the hop-dogs may make the cocoon on walls and fences and hedgerows near at hand. The same treatment as for the former will apply to this insect.

The Gold-Tail Moth (*Porthesia auriflua*).

Another caterpillar frequently found devouring Rose leaves is that of the Gold Tail Moth.

The moth has beautiful satiny white wings, and is found in August with its wings folded downwards on leaves, palings, lamps, etc. The thorax and abdomen are also snowy white, but the latter has a golden yellow tail tuft (Plate VII., Fig. 11). The female is about

1½ inches; the male can be told by having a dusky spot on each forewing and is slightly smaller than the female. This insect is widely distributed over Britain and feeds in the larval stage on a variety of fruit and forest trees as well as the Rose.

LIFE HISTORY AND HABITS.

The moths lay their eggs on the leaves. They are placed in golden coloured nests of hairs, derived from the female tail. In from seven to ten days the small larvæ come forth and feed upon the leaves until late in the autumn; they then go into winter quarters, sheltering in bark crevices, under bark scales, moss, etc., where they spin small dull grey cocoons about one-fourth of an inch long and remain in a dormant condition all the winter. At this time their size is seldom much more than one-fourth of an inch long. In spring they come out of these cocoons and commence to feed on the leaves. The caterpillar, when mature is a brownish-black with a bright red line down the back, a red line on each side spotted with white and another above the legs, and there are numerous tufts of brown hairs.

When mature they reach over an inch in length and then spin a grey cocoon of silk mingled with hairs in which they change to a deep brown pupa. These cocoons are usually found near the Rose or other food plant, often between the leaves.

PREVENTION AND TREATMENT.

When and where these moths are abundant it is advisable to go over the Rose bushes in winter to see if there are any winter cocoons about, and if so destroy them.

The caterpillars, if present in numbers, may be killed with arsenate of lead, or if in small numbers should be hand-picked.

The Buff-Tip Moth (*Pygaera bucephala*).

In late summer and on into the autumn Roses are always liable to be attacked by the caterpillars of the Buff-Tip Moth. They produce two quite different effects on the foliage according to their age. The young eat the epidermis only and feed in colonies close together. Later they spread out over the bushes and devour the leaves wholesale. A single caterpillar will do endless damage on a Rose bush. The moth is very beautiful, the fore wings are ashy and silvery grey with two indistinct transverse streaks and a large pale ochreous or buff spot at the tip; hind wings pale yellowish white. Wing expanse $2\frac{1}{2}$ to $2\frac{3}{4}$ inches (Plate VI., Fig. 6).

LIFE HISTORY AND HABITS.

The moth appears in June and July. The eggs are laid in batches, either on the upper or under side of the leaves; they are round, the upper part pearly white with a medium dark spot, the lower green. They take 10 to 14 days to hatch and are laid in groups of from 20 to 50. The larvæ are gregarious and reach two inches in length when mature. The ground colour is dark yellow, a broad black line runs down the back, and on each side are three lines which are interrupted by yellow transverse bands on the segments and there are fine hairs over the body. They mostly mature by September and reach $2\frac{1}{2}$ to 3 inches in length and when full fed fall to the ground and pupate in the soil. The pupa is dark brown, about an inch in length, with two spines at the apex. They remain under the trees until the next summer (Plate VI., Figs. 7 & 8).

TREATMENT.

The only thing that need be done is to pick off the groups of young larvæ before they disperse. If the large ones are found they can easily be jarred off on to the ground and killed there, or arsenical spraying may be resorted to if the attack is on a large scale.

The Dagger Moth (*Acronycta psi.*)

The caterpillar of the Dagger Moth is one of the many omnivorous kinds, which only too frequently feed upon the leaves of Roses in the late summer and early autumn. They usually occur as isolated specimens on the bushes, but owing to their ravenous nature cause much unsightliness and damage. The caterpillar is very marked; it is greyish-black with a broad pale yellow line along the back and a large blunt black hump on the fifth segment and a short one on the twelfth. It is found from August to October, and when mature reaches $1\frac{1}{2}$ inches long (Plate VII., Fig. 9). It feeds upon the Rose leaves, eating down to the mid rib and when mature pupates in a cocoon amongst any protection on the ground (Plate VII., Fig. 10). The moth appears in June, July and August and is found flying at night in gardens and lanes. The front wings are grey with dark marks as shown in the figure (Plate VII., Fig. 12). Length of wing expanse $1\frac{1}{2}$ inch. The closely allied DARK DAGGER (*A. tridens*) is also reported on Roses; the adult is very similar but smaller. Its caterpillar is orange yellow above with a small hump on the 5th segment and a whitish black-crowned one on the 12th. They may be found every year on Roses in September. As both species usually only occur singly, the simple method of hand-picking alone is necessary.

The Winter Moth (*Cheimatobia brumata*).

This well-known fruit pest, unfortunately, makes invasions also on our Roses, and in some years does endless damage. Unlike the Dagger Moth larvæ, which come later in the year, the "Canker-worms" or Looper larvæ of the Winter Moth commence their ravages when the Rose leaves are quite young and tender, and they also attack the young blossom buds.

The Winter Moth caterpillar feeds on all sorts of forest trees, fruit trees, shrubs and many ornamental plants. Roses may become invaded where they are near any fruit or forest plantation, for we know the males can carry the almost wingless females some distance.

The writer has seen Roses as badly damaged by this pest as fruit trees, when growing in the kitchen gardens or near an orchard.

The female Winter Moth is shown on Plate VI., Fig. 9, and the male, Fig. 10, both natural size.

LIFE-HISTORY AND HABITS.

The winged males appear early in October and are found flying at dark along the hedgerows and orchards, and you will notice them the same in the Rose garden. The females crawl forth from the ground some days after the males have made their appearance, and at once crawl up the stems of the Rose bushes. After being fertilised by the males, who may carry them from bush to bush or from an apple tree to a Rose, they lay their eggs on the Rose bushes, both on pruned surfaces and at the axils of buds. The ova are spindle shaped, greenish at first, then

1 & 2. MOTTLED UMBER MOTH 3 & 4. TORTRIX MOTH or ROSE MAGGOT
(page 48). (page 49).

5 & 6. LARGE TORTRIX MOTH or ROSE MAGGOT (page 48).

7 & 8. PALE TUSSOCK MOTH, Caterpillar $\frac{1}{2}$ natural size (page 41).

9, 10 & 12. DAGGER MOTH (page 45).

11 GOLD TAIL MOTH (page 42).

they become dark, then reddish and have a sculptured shell. These eggs remain on the Roses all the winter, and in late March and April they hatch into small caterpillars, so small we can scarcely detect them. At first they are greyish, then they became green with pale stripes. Their mode of progression is very characteristic, being always in a series of loops. Unlike most caterpillars these Winter Moth larvæ have only one pair of prolegs or sucker feet, whilst those of the Dagger Moth, Gold Tail and Tortrix have four pairs. This character is common to all "Looper larvæ." (*Vide* Plate VI., Fig. 11).

They at first spin the Rose leaves together and later eat into the blossom buds. When full grown, sometime in June, they attain an inch to a little more in length. On reaching maturity they fall to the ground, burrow under it and pupate. The pupal stage is passed in the soil in a case (cocoon) covered with earth outside and in these they remain until the next autumn.

PREVENTION AND TREATMENT.

The method of preventing this pest in fruit plantations is to tie a piece of grease-proof paper around the tree, smear it with grease by the first week in October and so catch the females as they ascend to lay their eggs. One would scarcely think of doing this to one's standard Roses. Yet it *might be* worth while if the grower suffers from this pest. But we get them on all Roses, and it is better to spray early in the season with the arsenate of lead wash, for many other leaf-eating caterpillars will also be destroyed (not all, unless done three times in the year with Roses).

The Mottled Umber Moth (*Hybernia defoliaria*).

This is another "Looper" often found on the Rose. The caterpillar is brown, almost reddish-brown, above with yellowish sides and reaches an inch and a half long. It appears a little later than the winter moth, and although not so common is nevertheless widely distributed as a Rose insect.

The female (Plate VII., Fig. 2) is quite wingless and the male (Fig. 1) is much larger than "*brumata*."

The Tortrix Moth or "Rose Maggot."

These little moths, of which many occur feeding on the leaves, blossoms, etc., of Roses, are frequently of such a serious nature that they completely destroy the first blossoming.

The Tortrices are all small moths, seldom more than three-quarters of an inch across the wings. The fore wings are always truncated at their apex. The larvæ, or caterpillars, often called "Rose Maggots," are typical, having six jointed legs in front, four pairs of sucker feet below, in the middle of the body, and a pair at the tail end (Plate VII., Figs. 5 & 6).

There are no popular names to many of the different species, a few only of which are mentioned here.

The Red Rose Maggot (*Pardia tripunctata*).

From personal observations I should say this is one of the two worst species of Tortrix. The "Maggots" eat not only the leaves which they spin together, but also eat their way into the buds and quite ruin them. Moreover, their "frass," or excreta, frequently accompanied with a brown moisture, disfigures the leaves below.

This larva or maggot is dirty reddish-brown, with a black head. As it matures it grows fat and sluggish and reaches about half an inch in length. They are found in May, June and July. On reaching the full fed stage the "maggot" changes to a dark brown pupa which is spun up amongst the leaves more or less enshrouded in pale silk.

The moth appears in May and June and, it seems, again in the late summer. Its fore wings are smoky-brown at the base, then whitish with grey clouding, leaden towards the tip with four small black specks; under wings grey. Length, about two-thirds of an inch. It is generally abundant in gardens.

The Brown Rose Grub (*Spilonota roborana*)

Another very common and harmful species, which is shown on Plate VII., Figs. 3 & 4, the fore wings dark brown at the base, the mid area white speckled with grey, tip darker, a leaden grey spot on the inner corner and brown palpi. Length, about the same as the former species. This moth is found on the wing in June and July. The maggot is dull brown with a black head, and like the former becomes very fat as it matures. They especially occur on the shoots, the young leaves of which are spun together and the buds eaten into. The damage done by them when they are nearing maturity in May and June is very marked. The date of appearance is in early April in some years, late April in others. Pupation takes place in tightly spun up cocoons formed partly of a rolled piece of leaf.

The Green Rose Maggot (*Tortrix ribeana*).

Feeding between spun together leaves we also find green *Tortrix* maggots. One common species is that

named above. The caterpillar is dull olive to bluish-green with small dark spots and with a black or green head. In length they are about [the same as the previously described forms. We notice them first in May, but they hatch out in April, and soon commence to feed and spin the leaves together, but not markedly until over half grown. Pupation also takes place amongst the leaves. The moth comes out in June and July. It varies from about half to two-thirds of an inch across the wings. The fore wings are pale yellowish-brown with darker markings as shown in the figure. Generally common over Britain and feeds on many other shrubs and trees.

The Yellow Rose Grub (*Cræsia holmiana*).

This pretty little moth is often very plentiful in gardens and lays her eggs on Apple and Rose. It occurs in June [and July. The fore wings are dark orange, suffused with] lead colour at the hind area and with a prominent white triangular spot on the costa; hind wings grey. The larva is yellowish with a pale reddish-brown head.

Another pretty species is *Cræsia bergmanniana*, whose fore wings are pale yellow reticulated with orange, with a silvery bluish transverse line before, a second beyond the middle and another on the hind margin. It occurs from June to August. The maggot is pale yellowish-green; the head and second segment black. It is most noticeable in May and June.

So many others occur in different localities that it is impossible to detail them here.

TREATMENT FOR ROSE GRUBS.

The most general plan is to wait until we see the buds being eaten, the leaves ruined and then pinch the grub in the leaf and kill it.

What we want to do is to prevent these creatures from doing any damage, and this can only be done by spraying with arsenate of lead early in the year, say the middle of April and not later than mid May. Perhaps this will have to be done twice, but at the same time we poison the foliage for many of the other Rose caterpillars.

The Rose Leaf-Miner (*Nepticula anomalella*).

The leaves of Rose bushes in the months of July and October are frequently found to be marked with serpentine pale tracks, with a dark central line (Plate VIII., Fig. 3). On opening one of these we find inside the tunnel a small amber-yellow, semi-transparent maggot with a dark yellow central line with a dark head; in size about one-sixth of an inch (Plate VIII., Fig. 2).

This is the larva of a minute moth—one of the *Tineinæ*, a group of very small moths with long fringes to their wings. This attack on the leaves is sometimes quite harmful, but it is mainly on the coarser kinds of Roses that we are troubled with this pest.

LIFE-HISTORY AND HABITS.

The moth appears first in May. The wing expanse is a little more than one sixth of an inch. The front wings are pale bronze, a little paler beyond the middle, the apex abruptly dark violet and the fringe long and grey; the hind wings are grey with pale cilia; thorax the same colour as the base of the wings and the body dark grey (Plate VIII., Fig. 1). We find them resting on the Rose leaves, and on palings, stakes, etc.

The egg is laid on the under surface of the Rose leaf close to a rib, and the larva on hatching in a few days bores into the leaf and gradually forms the tunnel, leaving its "frass" behind, thus forming the dark central line. When full grown the larva opens the upper skin of the leaf and crawls out and proceeds to the foot-stalk of the leaf and there spins a small orange-coloured cocoon in which it pupates. From this the moth hatches in two to three weeks, as a second brood in August, and the same takes place again.

The larvæ of this second brood, however, pupate in the cocoons attached to the stem, stalk or under a thorn, and also in the ground (Plate VIII., Fig. 4). There they remain as pupæ until next May. We may find the larvæ of the second brood in tunnels as late as November. This leaf-miner is generally distributed over the south, west, east and middle of England.

TREATMENT.

Where it is plentiful it is well to go over the bushes in June and pick off all the mined leaves and burn them.

So far, no good results have been obtained by spraying.

APHIDES, SCALE INSECTS, FROG-HOPPERS, AND LEAF-HOPPERS (*Hemiptera*) INJURIOUS TO ROSES.

We find three groups of the piercing-mouthed insects to be harmful to Roses in this country, namely, (i) the Plant Lice, Green Fly or Aphides, (ii) the Scale Insects, and (iii.) the Leaf-hopper and Cuckoo Spit insects. The two first-named belong to the hemiptera-homoptera (with uniform wings), the last to the hemiptera heteroptera (anterior wings differ

from the posterior in texture). All the hemiptera, we must bear in mind, are sucking-mouthed insects, which are provided with a long proboscis, which they insert into the tissue of the plant and suck out the sap (haustellate insects). We must also remember that they develop by an incomplete metamorphosis, and thus feed during the whole of their life. Many, as we know only too well, is the case with the Plant Lice, are very harmful to vegetation. They have most remarkable reproductive energy, increasing very rapidly at certain times and under certain favourable conditions, which at present we cannot foretell, and about which we know little or nothing.

Green Fly or Rose Aphis (*Siphonophora dirhoda*, *Siphonophora rosae*, *Siphonophora rosarum*).

The Rose Aphides or Green Fly belong to three distinct species mentioned above. As is too well known, they are the bane of the Rose grower's life, owing to their extraordinary rate of increase, and their persistent attack resulting in serious damage to the young shoots.

A general account of Plant Lice will cover all but a few details to which the Rose grower has to contend with.

The Aphides are insects which exist as species in several different forms. There are winged and wingless races of females, and the winged females may be of two kinds—those which produce their young viviparously and those which deposit eggs. Then there are males, which may or may not be winged.

The simplest form of Aphis is the apterous female.

This female consists of a globular body, the head, thorax and abdomen more or less merging into one mass. All that we need notice is the presence of the cornicles or honey-tubes, the curious glands in the skin, the piercing mouth and the two-jointed feet (Plate VIII., Fig. 7., the upper right-hand Fig.)

The cornicles are two tubular horns on the upper surface of the abdomen, through which the insects pass out a sweet, gummy excretion called "honey-dew." Honey-dew is one of the causes of the dying of the Rose leaves, for it falls from the Green Fly, covers the leaves and prevents respiration. Later it becomes covered with excrement and black fungus growth. The glands on the back are also important to remember, because it is through them that the skin becomes covered with a mealy, waxy or thread-like substance that repels water, and hence, if we wish to corrode the skin, we must use something that will hold the corrosive substance.

The structure of the foot at once separates the Aphis or Green Fly from the Scale insect, which has only one segment forming the foot. The respiration of an Aphis is, as in all insects, by means of breathing pores at the sides of the body. To kill them their pores must be closed by some sticky substance. One of the most remarkable things in the bionomics of the Aphides is the extraordinary rate and method of reproduction.

During a great part of their life-cycle they reproduce asexually, that is without the presence of a male Aphis. This method of producing their progeny alive is called *parthenogenesis*. It may continue for several generations. The young themselves soon reach sexual maturity and reproduce again.

1, 2, 3 & 4. ROSE LEAF-MINER (page 51).

5 & 6. FROG-HOPPER or CUCKOO-SPIT INSECT (page 62).

7. GREEN FLY or ROSE APHIS, four illustrations (page 53).

8 & 9. ROSE LEAF-HOPPER
(page 64).

10. HOVER FLY
(page 56).

11. LACE WING FLY
(page 56).

12. THE TWO-SPOTTED LADY BIRD (page 56).

Normally the life-cycle is as follows:—In spring we start with what is called a Mother Queen or Stem Mother—a wingless female. This parent produces a sexually living young—called “lice,” really the larval stage. These larvæ soon mature and produce other wingless females, and so on until the plant becomes smothered (Plate VIII., Fig. 7, the lowest of the four Figs.), and then the wingless forms develop wing-buds—in fact become pupæ, which give rise to winged females which fly off to other plants and produce wingless creatures like their parents (Plate VIII., Fig. 7, the middle Fig.)

These winged forms may fly off to the same kind of plant, for instance from one Rose to another, or they may fly off to quite a different sort of plant, as from the Rose to corn or the teasel.

This migration is very important to notice.

In any case, at the end of the season there are produced males as well as females. These autumn females are called the oviparous or egg-laying generation, and they, after having been fertilised by the males, deposit eggs upon the plant.

These eggs remain all the winter in the axils of buds, on the stems, &c. They are visible to the naked eye if searched for carefully on the Roses. In form they are spindle-shaped, the shell is shiny and the colour black (Plate VIII., Fig. 7, the upper left-hand Fig.)

Thus we have during the summer reproduction by a sexual method, in autumn sexual reproduction occurs and eggs, not living young, may be produced.

The rate of reproduction in plant lice is enormous, under certain conditions. Hence the reason we find the tip of the Rose shoots suddenly covered with green and

red fly. A single winged female has settled there, and in a day or so has produced many living young, which in their turn are seen to be doing likewise.

Three well-marked Aphides occur on the Roses in this country, namely, *Siphonophora rosarum*, *S. dirhoda* and *S. rosæ*.

The first-named lives, as far as we know, permanently on the Rose. The second migrates to wheat, grasses and polygonum, and the last to the teasel.

This migration accounts for the often sudden disappearance of the "fly" from Roses, and their equally sudden re-appearance in September, and in the case of *S. rosæ* sometimes as late as October.

Aphis Enemies.—Fortunately the Aphides have many natural enemies, which to some extent keep their numbers down.

The more important of these are shown on Plate VIII., namely, the Lady Bird Beetles (*Coccinellidæ*), (Fig. 12), the Hover Flies (*Syrphidæ*) (Fig. 10), the Aphis Lion or Lace Wing Flies (*Chrysopidæ*) (Fig. 11), various Ichneumon and Chalcid Flies.

The last-mentioned lay their eggs in the Aphides, and the maggots feed on the Aphides internally. They, as it were, hollow them out, and we find the dried skins as pearl-like bodies sticking to the leaves and shoots.

The Lace Wing Fly, who lays her eggs on curious long stalks on the leaves, feeds upon the Aphis in the larval stage, the larva being provided with large sickle-shaped jaws for picking the Green Fly off the plants, and to enable them to suck the juices from them.

Hover Flies drop their white eggs amongst a colony of the Dolphins, and the resulting maggots feed ravenously upon them. They are rather horrid creatures, somewhat leech-like and green, grey or reddish in colour.

The Lady Birds do good in both stages, for adults and larvæ ("niggers") feed upon these pests incessantly.

In spite of all these "natural checks" the Roses become covered and spoiled by plant lice, and man has to help himself and cannot rely on nature to do everything. Ants are usually found amongst a colony of Aphides; they go to them to extract the honey-dew.

PREVENTION AND TREATMENT.

It is quite impossible to do away with the second host plant of *S. dirhoda*, but some good may be done by keeping all teasels away from our gardens and rosaries, and so check the *S. rosæ*. Aphis may easily be kept in check on Roses by spraying, but this must be done with care. The writer has seen Roses as badly damaged by the washes used as by the Green Fly.

The reason is the Rose will *not* stand any strong corrosive spray. A particular Rose may do so at one time, but at another it will have its foliage ruined.

Moreover, a strong corrosive wash is not necessary to kill Aphides. All that we have to do is to block up the breathing pores, and so asphyxiate them. This may be done with simple soft-soap and water. For the spraying of Roses you must get the best soap, and not use more than 1-lb of soap to 25 gallons of water. To this may be added 2½-lbs. of quassia chips. The effect of the latter is undoubtedly most beneficial, for it acts as a stimulant and cleanser to the leaves, and by many

growers is said to have a direct effect on the Aphides. The soft-soap, of course, has some corrosive power, for it contains caustic soda (about 4 per cent.)

This soft-soap and quassia wash is made as follows:— Dissolve the soap in boiling *soft water*; boil the quassia chips or let them simmer for about 12 hours, adding water enough to keep them covered every now and then, strain off the liquid extract and pour into the dissolved soft-soap and well stir, and lastly add the full quantity of water of dilution. This is all that is required to kill Aphis. But we must remember two things, first that the living young inside the females are *not* hit by the wash, and that the wash does *not* kill the females at once. So many young will escape before the parents die, and even have been seen protruding forth after their death.

To clear the Roses, then, we must spray twice in succession on two consecutive days.

Paraffin emulsion of various strengths and forms have been recommended. They are usually harmful to the bushes, and the corrosive paraffin is not necessary for the purpose. Growers should be cautioned against its use. It is frequently found advisable to wash the bushes with plain soft water two days after spraying, partly with the object of removing any soft-soap from the leaves, and partly to knock off the dead Aphis.

Scale Insects (*Coccidæ*).

So far a single species of Scale Insect has been reported to me as doing harm to Roses in this country, namely, the Scurvy Rose Scale (*Diaspis rosæ*). On two occasions I have found *Lecanium persicæ*, the Brown Scale on cultivated Roses and Newstead records two others, *Lecanium capreæ* and *Pulvinari vitis* var *ribesiæ*.

The Scale Insects are very harmful and many have a very wide distribution, being so easily carried on nursery stock and plants in general.

They are most interesting insects on account of their strange bionomics.

The scale which we notice on the Rose in the case of the Scurvy Scale is a product of the insect. Beneath this the female lives and degenerates. She produces eggs and from these hatch out little six-legged active larvæ which make their exit from beneath the scale. They wander about and eventually fix upon some spot on the Rose bushes. The young scale insect is provided with a long piercing mouth and this is inserted into the plant. After this an excretion is gradually formed over the back which, with the insects' cast skins, becomes the "scale." During its formation the active six-legged larva degenerates into a footless fleshy mass, the female.

If the larva is destined to become a male a different shaped scale is formed and the larva becomes a kind of pupa—a so-called propupa from which a winged insect is produced. The male scale insect escapes from under the covering and flies about. It has two wings and a long projecting penis by means of which the females are fertilized under their scales.

Many scale insects reproduce like the Plant Lice, that is asexually.

Such scales as the Brown Scales (*Lecanium*) have no true "scale"—the skin of the female merely hardens and forms a house as it were for the eggs.

Others are the Mealy Bugs (*Dactylopius*) which may occur on Roses under glass, have no scale at all. They are active all their life.

Scale insects are preyed upon by much the same enemies as Aphides, especially lady-birds, chalcid flies and birds, but none are equal to keeping them in check.

The Scurvy Rose Scale (*Diaspis rosæ*).

This insect, often called the Scurvy Rose Bug, is quite a common scale insect on wild Roses in the West of England, and I have found it on the Bramble. Newstead, the chief authority on scale insects, says it occurs freely on wild Roses in hedgerows and sheltered places in many parts of England. No personal observations have been made on it in the open in Kent, Surrey or Sussex, but some bad attacks have been seen under glass. In Devonshire I have had it reported as very harmful, and at Budleigh Salterton I found it killing standards, owing to its great and rapid increase. It also occurred on "ramblers" and Gloire de Dijon up a house in such numbers that they were gradually dying back. The Standards had even the buds attacked.

Newstead says the scale insect will attack the leaves under glass and in warmer climates than Britain in the open. The disease can easily be told by comparing it with the photo reproduced here, the curious white scurvy-like patches being very marked.

LIFE HISTORY AND HABITS.

The female "scale" is at first pure white, with a small yellow speck near the margin—the cast larval skin. In form, the "scale" is rounded and flat and rather thick.

The female is deep red to crimson, as also are the ova and the active six-legged young.

The male in this Coccid is often nearly as common as the female. The male scale is very small and elongated. It is white in colour in its young stage.

The adult males hatch out in May and June, and are bright coloured.

The females lay their eggs in August and the orange larvæ crawl out very soon from beneath the scales and wander over the bushes. At this time a badly attacked bush looks as if dusted with red powder.

The young larvæ soon settle down and gradually the scaly covering is formed and they either turn to the almost structureless female beneath or become the male puparia.

Out of doors there is only one brood or generation per annum, but I fancy under glass there are several broods during the year.

PREVENTION AND TREATMENT.

As this pest is frequently taken into gardens on briars it is very important to discard any which show the least trace of it.

Still better would it be to have *all* briars disinfected. This may be done by putting them in any closed shed and fumigating them with hydrocyanic acid gas. (Vide page 69.)

The best method of destroying this pest is to wash the stem and branches, etc., with paraffin emulsion in February.

But the use of paraffin should be avoided if possible, and I believe that spraying several times with soft-soap and quassia when the larvæ are appearing in August will prove quite as effectual. The Golden-crested Wren was found to prey upon this pest in Devon.

Frog-Hopper (*Cercopidae*). **The Cuckoo-Spit Insect**
(*Philaenus spumarius*).

The curious frothy white substance so frequently seen on Roses, which is popularly called Cuckoo-spit, is caused by an insect—one of the Cercopidae or Frog-flies, known as *Philaenus spumarius* (Plate VIII., Fig. 5).

There are seven of these “Frog-flies” found in Britain. One occurs on Alders (*Aphrophora alni*), another on Willows (*A. salicis*). Of the four *Philaenas* three occur on low plants and herbage. The only one found on the Rose by myself and sent by correspondents is the one mentioned here.

If we remove the frothy substance we find living in the moisture a yellowish creature, which is rather active. This is the young Frog-hopper.

It is found on other plants than the Rose, for instance in large numbers on hawthorn hedges.

The damage to Roses in some years is very great. The insects take up their abode at the base of the blossoms before they open, and kill them by the constant sucking of the sap. The result is the buds die and turn brown. Others are found at the base of the leaves and on the young shoots. The leaves fade and the whole shoots die away when several insects occur close together.

Photo by Mr Edenden.

FIG 1.

Rose leaves attacked by the LEAF-ROLLING SAWFLY
(Page 35).

The attack is usually worst in June, and is apparently not confined to any particular kinds of Roses in bad years. Roses trained against a wall or fence, however seem to be more attacked than bushes and standards in the open. Ramblers seem very susceptible to this pest.

LIFE HISTORY AND HABITS.

The adult "Frog-hoppers" may be found from July to October. Their curious form is shown in the figure (Plate VIII., Fig. 6). The colour is extremely variable, as many as thirteen varieties being known. The commonest form is figured here, but some are uni-colourous yellow, and some black. The species can always be told by the sides of the front wings (*elytra*) being distinctly rounded. The length varies from one-fifth to one-fourth of an inch. Like the preceding insects they have a sucking mouth, by means of which they draw out the sap. They can jump quite a considerable distance, and may be found in the summer on to October settled on various plants.

The "Frog-hoppers" have a larval and pupal stage, both of which are unable to hop and which produce the frothy-looking substance beneath which they live. These two stages are pale yellowish and are collectively called nymphs. The winged adults hibernate and lay their eggs on the plants in the following spring.

TREATMENT.

Nothing but spraying will do any good, unless we have the patience to go over all our bushes and hand pick them. But before we spray we must get rid of the froth over the nymphs. To do this a good syringing with plain water, applied with force is the best plan. Then follow with a syringing of dilute paraffin emulsion

or nicotine. As I said before, the former is dangerous to use on Roses. Experiments conducted last year showed that strong tobacco wash and soft-soap will kill the nymphs, and this is advised as it does not harm the bushes.

The tobacco wash is referred to in the last section.

The Rose Leaf-Hopper (*Typhlocyba rosæ*).

Rose leaves are frequently noticed late in the summer to become pale and mottled, or almost marbled (Plate VIII., Fig. 9). On examining the leaves there will be found beneath one or more dried grey insect skins; these are the cast skins of the Rose Leaf-Hopper (*Typhlocyba rosæ*), an insect which belongs to the same group of Hemiptera as the preceding pest. In warm, dry weather in late summer the damage they do is often very marked and causes the leaves to fall prematurely, and so prevents the proper maturing of the wood.

This insect has pale yellowish or dull white wings; the head and thorax are also whitish, and the abdomen also yellow. In length one-seventh to one-sixth of an inch (Plate VIII., Fig. 8).

LIFE HISTORY AND HABITS.

These little insects feed upon the leaves, and may be found in May on the Roses. They take flying leaps into the air when disturbed, the movement being conducted by means of their longish hind legs. The females place their eggs just under the skin of the leaf, up to four being laid in the leaf together. On the young hoppers hatching they eat their way out and feed on the under surface. These young or larvæ are pale yellowish, and before each moult they fix themselves firmly on to

the leaf by means of their proboscis—so firmly that when the skin is cast it remains attached to the leaf. The next stage is the pupal stage, an active stage like we see happens with the Aphis. The pupa has wing-buds, and like the larva feeds beneath the leaf. These two stages (nymphs) are often found side by side, and they do endless harm. Five moults take place before the nymph is matured and ready to change from a crawling into a hopping creature. The second brood appear in September and lay eggs. These hatch into larvæ. Winter is passed in larval, pupal and adult stages; the latter is unusual, however.

TREATMENT.

The young, when noticed on the leaves, may be killed by tobacco wash. The adults had best be jarred off the bushes on to tarred boards, or knocked off by a heavy spray of water on to the ground and there killed mechanically, or by spraying a 25 per cent. paraffin emulsion over them.

Thrips (*Thysanoptera*).

The Black Fly, Thunder Fly or Thrips is often found doing damage on Roses. The species is known as *Thrips vulgatissima*. Thrips are all small insects, the Rose pest being only one-twelfth of an inch long. They have four narrow wings, edged with long fine hairs. The body of the adult is black and the legs pale. The larvæ are wingless and reddish yellow, with the head, part of the thorax and the apex of the body black. The nymphs are very similar but brighter. The females lay their eggs on the leaves, and the adults and larvæ feed upon the foliage and even blossoms. The effect they produce on the leaves is very similar to that caused by Leaf-hoppers, namely, a mottling of the surface.

TREATMENT.

The best treatment for Thrips is copious syringing with cold water, but when the attack becomes very bad tobacco wash may be used.

Under glass fumigation with tobacco paper or cloth, repeated two or three times is the best plan.

In either case the Roses should be washed next day with plain water.

Red Spider (*Tetranychus sp.*)

No requests have ever been received for information or any reports of damage done by Red Spider on Roses out of doors. Under glass the well-known *Tetranychus telarius* now and again becomes troublesome. This *Acarus*—a mere moving speck—varies in colour, some are dull green, some semi-translucent, some red. It can at once be told from any of the insect pests by having eight legs. They live on the leaves, usually the under surface in colonies and spin a fine silken web, beneath which they lay their round eggs. The young are six-legged, but otherwise like the parents. The result of their working is that they cause first a marbling of the leaf, then it turns yellow and dies.

Under glass they may keep on breeding all the year through, and may get on to other plants. Red Spiders breathe through their skin, and they are protected by their webbing in the case of the *Tetranychus*. In consequence they are very difficult to destroy.

TREATMENT.

Out of doors there is no better plan than two or three sprayings with liver of sulphur at an interval of a few days, best perhaps at ten days interval.

In a greenhouse, so far, we can recommend no better plan than painting the pipes with flowers of sulphur mixed up into a paint. The heat, however, must not be great, or the fumes may come off too strong and do damage. A small amount of heat and the treatment carried on for three or four times will soon clean a house of this pest, but we must remember the fumes will not harm the eggs, and thus we must repeat it to kill those that hatch out some days (4—8) later.

WASHES USED FOR ROSE TREES.

Amongst the various methods of coping with insect attacks, the spraying or washing of the plants with some insecticide or fungicide has year by year become more popular. When we have to deal with a delicate plant like the Rose we must proceed with great caution, as any caustic substance is very likely to do more harm than the pests themselves.

For this reason we wish to discourage the use, in any form, of paraffin as an insecticide, and it is only advised as such in very exceptional circumstances.

The washes of greatest benefit for Rose pests are—
(1) Soft soap and quassia ; (2) Tobacco wash ; (3) Hellebore wash ; (4) Arsenate of lead ; and (5) Liver of sulphur.

(1) *Soft-soap and Quassia Wash*.—This is by far the best for Aphis or Green Fly, and young Scale Insects.

The quantities to use for Roses are as follows :—

Soft soap	$\frac{1}{2}$ -lb.
Quassia	1-lb.
Water	10 gallons.

(2) *Tobacco Wash*.—This is useful for Thrips, Leaf-hoppers and Cuckoo-Spit. The quantities are :—

Tobacco	½-lb.
Soft soap	1-lb.
Water (soft)	12 gallons.

Steep the tobacco in water for some days and then allow it to simmer over a fire for an hour ; pour off the liquid, well squash the leaves and proceed again as before, and add the second extract to the first. This extract may then be mixed with the dissolved soft soap.

(3) *Hellebore Wash*.—This wash is most useful for Sawflies. Hellebore is used as a fine powder to dust over these insects, but it is far best especially for Roses used as a spray. It is made as follows :—

1-oz. of fresh ground hellebore.
2-ozs. of flour.
3 gallons of water.

The hellebore and flour are mixed together with a little water and then mixed with the rest of the three gallons. It must be constantly stirred and sent out as a fine spray.

(4) *Arsenate of Lead*.—This is the only poisonous wash for Caterpillars that can be used on Roses. It may be obtained in a paste form known as Swift's Arsenate Paste, or may be made as follows.

Arsenate of soda (98 per cent.)	1-oz.
Acetate of lead (98 per cent.)	2½-ozs.
Water	10 gallons.

Place the two in water and stir until both are dissolved, then add to the rest of the water and apply as a fine spray. Paris green, which we have seen recommended, will do more harm to the Roses than the insects.

(5) *Liver of Sulphur Wash*.—Useful in attacks of Red Spider, and has fungicidal properties. For Roses no more than 1-oz. should be used to 10 gallons of water.

FUMIGATION WITH HYDROCYANIC ACID GAS.

The fumes of hydrocyanic acid gas are deadly to *all* forms of animal life if used strong enough. Consequently this process must be used with much care, not only because it is highly poisonous but because it is harmful to vegetation under certain conditions, about which we know very little at present.

It may, however, be used at great strength on dormant wood, and as treatment for cleaning briars is strongly to be recommended.

One must bear in mind the fact that the fumes are deadly poisonous to man, so that great care must be exercised in using it.

Proceed as follows:—Any air-tight chamber of known capacity may be used, and the briars should be placed within it. Then proceed to fumigate with the following :—

For every 300 cubic feet of space use :—

1-oz. of cyanide of potassium.

1-oz. of sulphuric acid.

4-ozs. water.

The acid is poured into the water in an earthenware jar, and then the cyanide is dropped into it and the fumes are allowed to rise for an hour.

The shed must be then well ventilated for some hours before being entered.

Half the quantities should be used on non-dormant wood. Special contrivances are made to drop the cyanide into the acid and water from outside the shed or box, so that any chance of danger from the fumes, which are deadly poisonous, are obviated. The cyanide should be at 98 per cent. strength, and the sulphuric at about 1.84 specific gravity. Sodium cyanide does as well and is cheaper than potassium cyanide.

Photo by Mr. Edenden.

FIG. 2.

Rose Leaf attacked by the LEAF-ROLLING SAWFLY
(Page 35).

GENERAL ACCOUNT OF INSECTS.

Insects belong to a group of animals called Arthropoda—jointed-limbed animals.

These jointed-limbed animals are very varied in structure, habits, and development.

Amongst this group of diverse forms we find such as the Crabs, Lobsters, Shrimps, Woodlice, Spiders, Ticks, Red Spiders, Harvest Bugs, Centipedes, Millepepes, and the true Insects.

All this assemblage of forms can be told from other animals by their segmented bodies, accompanied by two or more pairs of jointed limbs and other jointed structures attached to the head. As this little manual deals only with the true Insect Enemies of the Rose, it is necessary to point out what are the differences between true insects and the other jointed-limbed animals. These creatures are divided by Zoologists into four groups known as Crustacea, Arachnoidea, Myriapoda and Hexapoda.

Briefly they may be told by the following characters :

A.—CRUSTACEA (*Crabs, Lobsters, Woodlice, &c.*)
Mainly aquatic. The body is roughly divided into two regions, the so-called cephalo-thorax (head and thorax) and abdomen. There are organs of locomotion attached to the lower side of *most* of the segments of the body and they breathe by means of gills.

B.—MYRIAPODA (*Centipedes and Millepedes*). These animals have their head distinct and the rest of the body divided into a series of rings; they have always organs of locomotion (legs) on all the segments. In the beneficial Centipedes, one pair to each segment; in the injurious Millepedes, two pairs to all the segments except the first three.

C.—ARACHNOIDEA (*Spiders, Mites, &c.*) These have the head and thorax united (Spiders) or the head distinct from the more or less fused thorax and abdomen (Ticks and Red Spiders). They have *four pairs* of legs attached to the lower surface of the thorax, except the Gall Mites (Eriophyes), such as the Big Bud Mite of Currants, in which there are only *two* pairs.

D.—HEXAPODA (*True Insects*). These have *six* legs attached to the thorax—never *eight*, and none on the abdomen. They breathe by means of air tubes or trachea.

The creatures dealt with in this book are all six-legged or *hexapod* animals, what we popularly call Insects.*

STRUCTURE OF A TYPICAL INSECT.

A grasshopper will serve as the best example to study the structure of a typical insect. We can at once see that the body or trunk is divided into three portions called (1) head, (2) thorax, (3) abdomen. The head bears the following structures—antennæ, two kinds of eyes and the mouth.

* A note on the Red Spider is also included.

The *mouth* is composed of six pieces, namely, a pair of hard horny jaws called mandibles, a pair of soft jaws below called maxillæ or chewing jaws; a plate above, the upper lip and a platform below, really double, the lower lip. The maxillæ and lower lip each bear a jointed process on their sides, the maxillary and labial palps respectively. These palpi are sensory organs. The *eyes* are of two kinds, compound and simple. The former are large and are placed on each side of the head; they are composed of a number of hexagonal columns or facets; the eye resembling a piece of honey comb. The simple eyes may be absent or they may be two or three in number, situated on the summit of the head; they are seen as small raised points, easily noticeable in bees.

The *feelers* or *antennæ* are jointed processes of great diversity of form; they may be thread-like or plumose, pectinated or elbowed, etc. The antennæ often differ in form in the two sexes. They are sensory organs, being connected with the senses of smell and touch and possibly hearing.

The *thorax* or mid-body is normally composed of three rings, called the pro-, meso-, and meta-thorax. They may be quite separate as seen in a grasshopper, or more or less fused as seen in a bee.

The thorax carries the organs of locomotion, namely, wings and legs. The former are attached to the upper part of the thorax and may be of one or two pairs, or they may be absent (= *apterous insects*); the first pair of wings are attached to the mid-portion of the thorax. An insect wing normally is a thin membranous expansion, supported by rigid hollow ribs, called veins or nervures,

which contain air tubes, etc. The neuration of the wings is important in identifying insects. The wings are frequently much modified, for instance in a beetle, the front pair are hard, horny structures (= *elytra*).

The *legs* are attached to the lower part of the thorax ; they are either six or absent (= *apodal insects*). Each pair is united to a thoracic ring, the first are pro-thoracic legs, the second meso-thoracic, and the hind pair are meta-thoracic legs. The legs are jointed and are normally made up of nine segments ; the basal one is the coxa, this is followed by a small segment, the trochanter, then the long femur, and the tibia or shank, lastly the foot or tarsus, which is composed of from one to five segments. The last tarsal segment ends in two claws or ungues, which have between them differently shaped structures called pulvilli or pads, etc. There is much modification in insects legs, some are long and thin and adapted for running (Tiger beetles), others have them broadened and adapted to scraping in the soil (Mole Cricket), others for jumping (Grasshoppers and Locusts), yet others for swimming (Water-boatmen). The abdomen is composed of a varied number of rings or segments—each segment having an upper and lower moiety, united by a soft membrane, thus enabling the expansion of the abdomen ; there are soft areas also between the segments. No traces of organs of locomotion can be found on the abdomen, but it terminates in varied structures, such as a long egg-tube or ovipositor in some females (Ichneumon Flies), a sting (Bees and Wasps), or in the males in distinct clasper-like external sexual appendages. At the sides of the abdomen and thorax we find a series of slit-like openings ; these are called *spiracles*.

Photo by Mr. Edenden.

FIG. 3.

Rose leaves damaged by the ROSE SLUGWORM
(Page 36).

RESPIRATION OF INSECTS.

The spiracles are the breathing pores of the insect. Unlike the higher animals Insects do not breathe through their mouth, nor have they lungs, nor is the blood carried to the air to be oxygenated. Insects respire by means of a series of fine tubes called *trachea*, which run all over the body and carry air to the various parts. The trachea are cylindrical tubes and branch into smaller and smaller divisions ; they are thin-walled, but are supported by a spiral band. When an insect is opened and placed under water, these tubes look like silvery streaks, owing to the air they contain. The spiracles are openings of definite form and position at the sides of the abdomen and two pairs also on the chest, from which the main trunks of the air tubes arise. Each spiracle is kept open by a hard rim around the edge, and from this fine hard processes pass across the opening. Thus dust, etc., is stopped from entering the air tubes. It is these spiracles which we have to close up by some sticky substance adhering to them if we wish to kill such insects as Green Fly or Plant Lice. A few insects however breathe by kind of gills (May-fly larvæ), and others have part of the intestine modified (Dragon-fly larvæ) for respiration, but such do not need our attention here.

THE GROWTH & DEVELOPMENT OF INSECTS.

There is still lingering a popular idea that a small fly will grow into a large fly, a small bee into a large one. This is never the case. Insects in development pass through a series of changes, spoken of as the Transformation of insects or Metamorphosis. These

often complicated changes take place during and after a period of growth. The phases in the life of an insect are, first the egg stage, second the larva or caterpillar, third the pupa or chrysalis, and fourth the sexual adult. The changes in the egg, so-called embryonic changes need not concern us. The larval stage is the period of growth, the period of ravenous feeding, the time during which the majority of insect enemies of the Rose are so harmful. The caterpillar on leaving the egg shell is very small. It gradually grows until its skin is too small to contain the body contents. The skin then splits and the insect crawls forth from the old skin with a new one ready formed beneath, soft in texture and capable of expanding. This process of casting the skin is known as "Ecdysis." Several of these moults take place in the larval stage. Preceding, during, and just after the moult, the larva does not feed, and moreover is sluggish and tender. At this time it is often more easily killed by insecticides than at others (=freshly moulted green fly and leaf-hoppers).

At last the larva reaches maturity and then casts its skin for the last time and enters the third phase of life, the pupa or chrysalis. Previous to so doing, the larva either spins a cocoon of silk, attaches itself at its tail end to some object by silk, or enters the soil and forms a case of earth in which the pupal stage is found; a few pupæ are found nude in the soil, others in wood and seed.

This *pupal stage* is the period of metamorphosis or transformation. The pupa proper is incapable of any great movement, nor does it take food. It is the period when the greater part of the caterpillar's organisation is destroyed and remodelled into the adult.

Pupæ may be found in all manner of places, some in cocoons, others naked in the soil, in tunnels, in wood, etc., and they vary greatly in shape and slightly in colour. During this stage the different parts of the mature insect are formed, and these are seen marked out on the pupal shell. Some insects (Cecids or Gall Midges, etc.) pupate in the old larval skin, which forms what is called a *puparium*. Some aquatic pupæ, such as in the mosquitoes, are active, but still take no food.

COMPLETE & INCOMPLETE METAMORPHOSIS.

Insects such as the Rose Tortrix Moths undergo what is called complete metamorphosis, others such as the Rose Aphides an incomplete metamorphosis. Complete metamorphosis is where there are the following stages:—(1) an egg; (2) an active feeding, growing creature, the larva or caterpillar; (3) a quiescent, non-feeding, practically non-active pupæ; and (4) the active, sexually perfect adult. Such we find in bees, flies, beetles, moths and butterflies.

Insects which undergo *incomplete metamorphosis* are those which have no *true* pupal stage. There is the egg (1), then (2) the active growing larva, followed by (3) the *active* pupal stage—the nymph, which feeds and moves just as the larva or adult does; finally (4) we have the sexual adult.

The nymph stage is very like the larva, except that wing-buds appear at the sides of the thorax. There are insects with no metamorphosis at all (*Aptera*), but none of these do any harm to Roses.

BITING AND SUCKING-MOUTHED INSECTS.

Hexapods have two main types of mouth, namely, the biting mouth and the sucking mouth. The former are called "Mandibulate," the latter "Haustellate." The biting-mouthed insects, such as the beetle, have hard, horny, biting jaws, and gnaw their food. The sucking-mouthed insects have sharp piercing mouths, such as aphides and bugs, or non-piercing but sucking mouths, such as the house fly. The first live on the sap of plants and the blood of animals and man. The second the *external* juices of plants and animals. The mandibulate insects we can kill by covering the foliage with poison; this would not affect the Haustellate insects. The latter we have to kill by either blocking up their breathing pores, or by corroding their skin. Frequently, they are too powerful for either process to affect them. Then we must fall back on methods of trapping them. The leaf and blossom caterpillars are instances of biting-mouthed insects attacking the Rose. The Aphides and Scale Insects and Leaf-hoppers are instances of piercing-mouthed Rose pests.

ORDERS OF INSECTS.

Insects are divided into groups, called Orders. Each order is further divided into sub-orders, and families, and each family is composed of one or more smaller groups called genera, each genus being composed of one or more species. For practical purposes we may divide the Hexapoda into the following Orders:—

A.—Metamorphosis Complete.

Order I.—COLEOPTERA (Shield-Winged Insects). These are beetles. They have two pairs of wings. The

first pair are always hard and horny, folding over the body (*elytra*) ; the second pair are membranous. Mandibulate.

Order II. — LEPIDOPTERA (Scaly-winged Insects). Butterflies and Moths. The four broad membranous wings more or less covered with scales. The Butterflies (*Rhopalocera*) with club-like feelers, the Moths (*Heterocera*) with feathery, thread-like or pectinated antennæ. Haustellate when adult ; Mandibulate when larvæ.

Order III. — HYMENOPTERA (Membranous-winged Insects.) Ants, Bees, Wasps, Ichneumon Flies, &c. Four membranous transparent or nude wings with comparatively few veins. Mouth partly mandibulate, partly Haustellate.

Order IV. — DIPTERA (Two-winged Insects). Flies. Two wings only ; the second pair reduced to two small club-shaped processes called balancers. Haustellate.

B.—Metamorphosis Incomplete.

Order V. — HEMIPTERA (Half-winged Insects.) Plant Lice, Bugs, Scale Insects, &c. Four wings ; front pair either with basal area horny or leathery (Heteroptera or bugs) or transparent and uniform (Homoptera or Plant Lice). Mouth formed into a piercing proboscis.

Order VI. — ORTHOPTERA (Straight-winged Insects). Grasshoppers, Crickets, &c. Four wings, the first pair rather narrow, with more or less straight veins, the hind pair large and fan-shaped. Mandibulate.

Order VII. — NEUROPTERA (Lace-winged Insects).
 Dragon Flies, Lace-wing Flies, &c. Four more
 or less uniform wings with a dense network of
 veins. Mouth mandibulate.

C.—No Metamorphosis.

Order VIII.—APTERA (Wingless Insects). Spring-tails
 and Silver Fish. No wings.

Of these the chief orders found affecting Roses are
 the Coleoptera, Lepidoptera, Hymenoptera and Hemiptera.

From Journal of S.E. Agricultural College.

FIG. 4.

THE ROSE SCALE. (a) on old; (b) on young wood.
(Page 58).

THE ROSARIAN'S PEST CALENDAR.

BY MR. H. R. DARLINGTON.

Precautions to be taken and Enemies to be sought for throughout the Year.

N.B.—These notes have been compiled (except as to a few alternative receipts for Copper Solutions) from the directions given by the joint Authors of the "Enemies of the Rose."

MID-WINTER.

To destroy Fungus Spores—

Drench the Rose plants with

i.) Copper Sulphate: 1-oz. to 2-gals. of water (see page 18, note (3)),

or (ii.) Bordeaux Mixture:

Copper Sulphate	..	..	4-ozs.
Lime	..	..	2½-ozs.
Water	..	..	2 gallons

or (iii.) Cupram:

Carbonate of Copper	..	..	1-oz.
Liquid Ammonia	..	..	½-pint
Water	..	..	2 quarts

For use add 10 gallons of water. The advantage of Cupram is that it is liquid and does not clog the syringe and is less hurtful to plants than Copper Sulphate alone.

FEBRUARY.

To destroy Wintering Larvæ—

Spray with Paraffin Emulsion.

Dissolve 10-ozs. soft soap in one pint boiling water; add 5-ozs. paraffin, and stir vigorously. For use, dilute with 10 volumes of water.

MARCH.

Search for green larvæ of Sawflies (see pages 33-39).

Clear away and burn all prunings from plants that have suffered from fungus disease or insect attacks.

Spray with Arsenate of Lead (see page 68, note (4)) to destroy Winter Moth, Tortrix Moth, Grubs, &c.

APRIL.

Search for—

Caterpillars of Winter Moths (see pages 46 and 47).

Very small, at first greyish, then green with pale stripes.

Caterpillars of Mottled Umber Moth (reddish brown above with yellowish sides) (see page 48).

MAY.

Spray with Potassium Sulphide ($\frac{1}{2}$ -oz. to a gallon of water) the opening leaves to prevent attacks of fungus (see pages 23 and 25).

and through June and July

Look out for and hand pick—

Rose Beetles, Cockchafers, Sawflies, Rose Slugworm (pale yellowish green with black stripe and orange head, 1-6th inch long) (see pages 30-39).

Larvæ of Rose Slug Worm (see page 36).

Green Rose Maggot, especially in young shoots (spun together) (see page 49).

Brown Rose Grub ditto (see page 49).

Yellow Rose Grub (see page 50).

Red Rose Maggot (reddish brown) (see page 48).

Rose Leaf-Miner, and first brood of Rose Leaf-Hoppers (see pages 51 and 64).

Caterpillar of Vapourer Moth (dark grey, spotted red, five tufts of dark hair, $1\frac{1}{2}$ to 2-ins.) (see page 40).

Watch for first attack of Mildew on leaves, and spray with Sulphuric Acid (one part in 1,000 of water) or Potassium Sulphide, as above (see pages 22 and 23).

JUNE.

Search for Cuckoo-Spit insect, especially upon Roses on walls and Ramblers. Syringe with water or insecticide, or hand pick (see page 63).

and throughout the Summer

Watch for Green Fly and kill by syringing with soft soap or other insecticides (see page 57).

Watch for first outbreak of Rust or orange fungus; if on stem of plant rub off with Methyated Spirit (see page 25).

JULY.

Watch for and treat—

Second attack of Mildew (see page 21).

Black Spot (see page 25).

Rose Leaf-Scorch (see page 26).

and onwards till Autumn

Search for Rose Emphytus larvæ (dark green with white spots and white legs, curled under the leaf or holding on by front feet) (see page 38).

AUGUST.

Second brood larvæ of Rose Slugworm (see page 37).

Second brood of Rose Leaf-Miner (see page 52).

Eggs and larvæ of Rose Scale (see page 59).

AUGUST, SEPTEMBER, OCTOBER.

Search for and hand pick—

Caterpillar of pale Tussock Moth (yellowish green with four hairy tufts, found in clusters, $1\frac{1}{4}$ to $1\frac{1}{2}$ -in.) (see page 41).

Caterpillars of Gold-tail Moth (brownish black with bright red line down the back and along each side, spotted white, with tufts of brown hairs) (see page 42).

Caterpillar of Buff-tip Moth (dark yellow with broad black band down back and three lines on each side, $2\frac{1}{2}$ to $2\frac{3}{4}$ -ins., in groups) (see page 44).

Caterpillar of Dagger Moth (greyish black with broad pale yellow line down back, $1\frac{1}{2}$ -ins.) (see page 45).

Watch for and treat—

Third (and most serious) attack of Mildew, on stems or hips (see page 22).

Second brood of Rose Leaf-Hoppers (see page 65).

LATE AUTUMN.

Clear away all leaves attacked by Rose Rust (see page 24).

If the attack of Mildew or Rose Rust has been serious, remove the surface soil and replace with fresh soil *not* taken from the neighbourhood of briars.

ROSE TREE CANKER.

BY GEORGE MASSEE, V.M.H., F.L.S.,

*Principal of Cryptogamic Department and Plant Pathologist,
Kew Herbarium.*

This disease is of a physiological nature, and does not depend on fungi or insects for the primary cause. The appearance of the disease is well expressed by its popular name; the wood first shows signs of browning, the bark cracks, and as the disease progresses the wood is eaten away, or in other words becomes resolved into a soluble substance which melts away, leaving large, irregular gaps which often pass almost through the branch. It is often most evident near the base of the stem, near the junction of stock and scion.

Unfortunately no cure is known, which is what might be expected since the cause is unknown.

The disease is more prevalent in certain districts than in others, which suggests that substances present in certain soils have something to do with the matter. On the other hand, cases are known amongst other plants where a similar disease results from the stock acting prejudicially on the scion.

Some varieties of Roses are more prone to canker than others. Maréchal Neil often suffers severely.

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