1885.
NEW ZEALAND.

FRUIT-BLIGHTS AND DISEASES OF FRUIT-TREES IN NEW ZEALAND

(INTERIM REPORT ON, BY T. KIRK, F.L.S.).

Presented to both Houses of the General Assembly by Command of His Excellency.

Professor KIRK to the Hon. the MINISTER of LANDS.

SIR,— Wellington, 7th September, 1885.

In compliance with your instructions received by me, when in Christchurch, on the 27th February, I commenced inquiries concerning the various diseases of fruit-trees in the colony, and have now the honour to enclose an interim report containing the results of my inquiries, so far as I have been able to work up the material collected.

While I regret that the report is necessarily incomplete, I may point out that, owing to the advanced period of the season when your instructions were received, my researches were practically restricted to the winter months; it was therefore impossible to ascertain the life-history of many fruit-pests, or, in some cases, even to determine their identity; while my stay in any one district was too brief to allow of the work being performed in an exhaustive manner, more especially as it was carried on conjointly with the important forest work which had been placed in my hands.

I have satisfaction in stating generally that, although the ravages of insect and fungoid pests have assumed such formidable dimensions as to cause a serious diminution of the fruit-crop in several districts, the trouble has, in nearly every instance, been the result of ignorance of the nature of the evil itself and of the best remedies to be applied in each case. Even in the present imperfect state of our knowledge the enemies of the fruit-grower may be kept within moderate bounds, and, in most instances, completely eradicated; so that there is nothing in this direction to prevent fruit-cultivation from being placed in a satisfactory position throughout the colony.

I have to express my thanks for the ready help and assistance afforded me by fruit-growers and gardeners in all districts that I have visited.

I have, &c.,
T. KIRK.

The Hon. the Minister of Lands.

INTRODUCTORY REMARKS.

EXTENT OF INJURY.

IN the present stage of my inquiries it is not easy to form even an approximate idea of the amount of injury effected amongst fruit-trees by disease, insects, and fungi. I can do little more than indicate in general terms the chief causes of injury in each district.

As my work did not commence until I was on the point of leaving the Canterbury District for the North, I have at present no knowledge of the extent of injury effected in the southern districts.

In North Canterbury, so far as my observations went, the most serious pests are scale-insects and American blight, which have caused a vast amount of damage. Here, as elsewhere, the peach is almost destroyed, and has ceased to be a profitable fruit. The pear suffers from slug-leech.

In Westland scale and American blight are, on the whole, less destructive than in other places. The slug-leech, however, is very troublesome; and apprehensions were expressed with regard to a fly which is said to attack the plum and kill the young wood, but I was unable to obtain specimens of the insect.

Nelson and Marlborough have suffered more than any other parts of the colony, and the results are of a more painful character than elsewhere. Many settlers possessed of small holdings have derived the chief portion of their income from fruit-trees; these have become valueless, chiefly from scale and American blight. In most cases the loss could have been prevented by a little timely

attention, as both scale and blight may be easily extirpated. The codlin-moth has still further increased the injury; while the slug-leech has diminished the yield of pears and plums by a heavy percentage, and is increasing at such a rate that it is now attacking the walnut. The vine is prevented from fruiting by mildew, while canker-worm and other pests are still further reducing the yield of apricot, plum, apple, and small fruits.

I was assured that the export of fruit from Nelson ports had been diminished to a great extent, but was unable to procure particulars. Bearing in mind that a large percentage of the fruit-crop of Nelson is produced on small holdings, this diminution of the crop, in some cases, involves a considerable amount of privation. It is stated that many settlers are leaving the district to procure work in other localities.

At present I have but little knowledge of the blights of the Wellington, Taranaki, and Hawke's Bay Districts.

In the North Island the peach is everywhere decaying, but, notwithstanding the depressing effect produced by the general dying-out of the tree, I believe its vigour may be restored, and that the most important step in the way of restoration will be found indicated in my report.

Apple-scale, so troublesome in the South Island, is almost unknown in some districts in the North; although, from the way in which some native scale-insects are attacking cultivated fruit-trees, it will be necessary for growers to be very watchful in order to prevent their trees from becoming badly infested.

Boring insects are more frequent in the northern districts than elsewhere; all the ordinary cultivated fruit-trees are attacked, in many cases with fatal results.

White-scale *(Icerya purchasi)* is a serious enemy to the orange-grower, but may be destroyed with the greatest ease and at a trivial cost.

The slug-leech is common, and causes serious loss yearly.

Foot-rot is of a more dangerous character, and less easy to deal with.

The greatest scourge in the North is unquestionably root-fungus, which may be found attacking fruit-trees, forest-trees, hedge-rows, shrubs, and even grasses—from young plants in nursery-rows to trees in full bearing—with the most destructive effects.

RESTRICTIVE MEASURES.

The importation of diseased or affected fruits should be strictly prohibited. The orange-scale has been introduced with fruit from Sydney. Apples infested with codlin-moth and the apple-scale are occasionally imported. It forms no real objection to prohibition that an insect or fungus may already be established here, since a change of climate often conduces to increased vigour, and the newcomer increases with greater rapidity than its established congener.

It is desirable that imported fruit-trees should be inspected on landing, although there would be great difficulties in carrying out any efficient system of inspection, owing to the number of ports of entry, and the consequent cost of stationing a duly-qualified man at each. The difficulties attending the inspection of affected fruit are but slight; in nearly all cases the presence of the insect may be easily recognized. An officer of the Customs Department at each port might easily acquire such a knowledge of scale or of codlin-moth, for instance, as to be able to recognize affected fruit, and all fruit entered at that port should be examined by him. But the examination of living fruit-trees in order to detect the presence of minute fungi or of insect-ova would require special knowledge and exceptional powers of observation. The introduction of such a fungus as the "black knot," of California *(Sphœria morbosa)*, would be a serious aggravation of the evils under which fruit-growers have to labour; Aphidian insects of subterranean habits, as the currant-aphis, grape-louse, &c., might be introduced on the roots of plants. It is stated that the grape-louse of Australia attacks various kinds of plants; if this be correct, it might be introduced into the colony any day, although the importation of the vine is strictly prohibited.

The appointment of inspectors, with power to order the destruction of any affected trees, has been advocated, but no absolute necessity for such a measure has been made out at present; and with the more general diffusion of information about the diseases of plants it is not probable that such need will arise.

The Codlin-Moth Act is strictly permissive, and at present has not been adopted in a single district, although the insect is generally distributed through the colony, and in some localities has materially diminished the annual yield.

PREVENTION AND REMEDIES.

The climate of New Zealand is exceptionally favourable to the rapid increase and vigorous growth of insects and plants introduced from temperate countries. European insects and weeds, when introduced, flourish with a vigour rarely exhibited in their native country, and increase with greater rapidity. But this is not all: under the new conditions induced by extensive cultivation the food-supply of many native pests has been increased to an unlimited extent, so that it is no matter for surprise that the grass-grub, lemon-tree-borer, and several species of scale are found in ever-increasing numbers, and give good promise of excelling their imported allies in their powers of destruction.

In former years fruit-cultivation was carried on under easier conditions: few insects had been introduced, and indigenous kinds had not discovered the more enticing food-supply afforded by introduced fruit-trees. All this is changed: a tree is no sooner planted than it is in danger of being attacked, and requires to be frequently inspected in order that noxious insects and fungi may be destroyed on their first appearance. The intending fruit-grower should consider this risk before planting. Unless he determines beforehand that his trees shall be kept clean at any cost, his anticipations of profit will be disappointed, and his orchards will be a source of infection for the whole country side.

As a general rule, the old method of growing tall orchard trees, with large spreading heads, will be found to place fruit-growers in New Zealand at a disadvantage when compared with the plan of growing dwarf trees occupying a smaller space. These have the advantage of being more easily sheltered from the high winds which visit most parts of the colony during the flowering season, and in exposed situations often cause a serious diminution in the crop. An advantage of still greater moment is found in the increased facilities afforded for detecting the first appearance of noxious insects, and for the application of measures to insure their prompt extirpation. It is difficult, if not impossible, to keep large-headed orchard-trees free from insect-pests; it is comparatively easy to keep trees 8ft. or 10ft. high in a clean condition, whatever mode of growth may be adopted.

The difficulty of keeping free-growing varieties of apple worked on blight-proof stocks in a dwarf condition may be obviated by double-grafting, the stock to be first worked well above the ground with the "Paradise," and that in its turn with the variety required for permanent fruiting.

Unless grown in the pyramidal form, fruit-trees should, as a general rule, be kept open in the centre, so as to admit the greatest possible amount of light and air. Insects increase most rapidly in proportion as they find shelter and protection on the trees which they infest.

In old neglected apple-orchards, where the branches are allowed to become interlaced and almost shut out the light of day, patches of American blight may be seen with the cottony outgrowth three inches in length. When shelter is abundant the natural enemies of the insect have less chance of attacking it.

Prunings and thinnings from affected trees should be promptly destroyed; insects and fungi are often established in new localities by neglect of this simple precaution.

Moss and lichen should not be allowed to grow on the trunks and branches; grass and weeds should be eradicated from about the roots. No useless growth should be permitted, and everything calculated to afford needless shelter to insects should be removed.

The results of the application of insecticides should be carefully watched, and the treatment promptly repeated, if found necessary.

In the majority of cases insects may be extirpated with but little trouble on their first appearance; but if they are allowed to increase until the entire orchard is affected their extirpation will involve a large expenditure of time and labour. Constant watchfulness against insect-pests, and promptitude in meeting their attack, will be found golden means for fruit-growers in New Zealand.

It seems advisable to offer a few general remarks upon the remedies applicable to the chief classes of noxious insects, referring for fuller particulars of treatment to the detailed account given under each species.

Scale.

No insects are more easily destroyed than the apple-scale and its allies with horny shields; the castor-oil mixture, recommended under apple-scale, has never failed when properly applied. It is inexpensive, easily applied, and harmless to vegetation. It should be used during the winter or early spring months, before the commencement of growth, and should be applied with a light hand. In excessive quantities it tends to retard growth, but does no permanent harm.

In all respects I prefer castor-oil to kerosene as an insecticide: it is equally destructive to insect-life, and does not injure the plant, as is often the case with kerosene. For those who prefer kerosene emulsions, I would recommend 1lb. soft soap, dissolved in a gallon of boiling water, with the addition of a pint of kerosene.

Insecticides consisting chiefly of oils should always be applied lightly, as for the most part they cause injury to the superficial tissue of the plant.

Mr. Weisenhavern, Mr. Budden, Mr. Hale, and other fruit-growers informed me that hundreds of fruit-trees had been recently killed in and about Nelson by the use of kerosene, or kerosene and linseed-oil, to destroy scale.

White Scale *(Icerya)*.

Syringing, or spraying with a garden-engine, with a solution of caustic potash, 1oz. to a gallon of water, is most effective; or the castor-oil mixture will be found excellent. Emulsions of turpentine and milk, or soapsuds applied with the syringe, would be of high value.

"Concentrated lye" is strongly recommended by American cultivators as a remedy for scale. Its cost here would be 6d. or 7d. per lb. wholesale. It is applied with a syringe or garden-engine, in the proportion of 1lb. of lye to a gallon of water; stronger solutions are injurious to the tree.

It is said to contain about 8 per cent. of caustic potash, the remainder consisting of carbonate of soda, with a small percentage of caustic soda.

I am satisfied that equally good results may be obtained with caustic potash alone, in the proportion of 1½oz. to a gallon of water, at a cost of 1d. or 1¼d. at most.

Canker-worm and other Small Caterpillars.

Syringing freely with weak solutions of caustic potash. Dusting the trees with Paris-green has been found beneficial, but great care should be taken in applying this remedy. Should it fall on a cut or wound on the hand or elsewhere, the results might be of an unpleasant character.

Leaf-aphis.

Syringe freely with soapsuds or even with cold water. In most cases this will be found sufficient to dislodge the insect, but with some kinds it may be necessary to use a weak solution of caustic potash.

The aphides infesting fruit-trees in New Zealand appear to be identical with European species.

Slug-leech.

White hellebore powder has been found effective, but I believe the caustic-potash solution would be even more beneficial.

Leaf-fungi.

I believe solutions of permanganate of potash would be found effective with nearly all fungoid pests attacking the leaves. I hope to carry out a series of experiments in this direction during the coming spring. Dusting the leaves affected with fungi with sublimed sulphur or with Goodhue's mixture will be found productive of good results.

Root-fungus.

In addition to tar-water, I have to suggest the following experiments with a view of eradicating this pest: (1.) Top-dressing of lime, at the rate of twelve bushels to the acre, to be dug in and well mixed with the soil. (2.) The same, with the addition of 1lb. of sulphur to each bushel of lime. (3.) Top-dressing of soot, at the rate of ten bushels to the acre. (4.) Top-dressing of salt, at the rate of 3cwt. to the acre, applied in the autumn.

Mr. Goodhue's mixture applied in the dry state is destructive to the chermes infesting pines, and to many other insects, as well as to the black blight of the lemon. If prepared for market and placed before the public in a convenient form, it would doubtless meet with ready sale, as it is an insecticide of considerable value, and easy of application.

With one important exception—the use of blight-resisting stocks for the apple—the cultivation of plants possessing properties which render them distasteful or even poisonous to certain insects has not received the attention it deserves, although it opens a field rich with promise. A few instances may be mentioned here. The common garden nasturtium, planted amongst apples, and allowed to ascend their trunks, is a preservative against American blight; white mustard sown amongst turnips protects them from the attacks of wire-worm; the beetle of the grass-grub, under certain conditions, feeds on the castor-oil plant with suicidal results; the cabbage-aphis is repelled by the tomato; *Isatis tinctoria*, the ancient woad, protects root-crops from attacks of the larvæ of various beetles; and it is stated that the common flax *(Linum usitatissimum)* grown amongst potatoes will avert the attacks of the Colarado beetle.

Facts of this kind demonstrate one class of the advantages that might be obtained from an experimental garden under competent supervision.

THE CHIEF DISEASES OF FRUIT-TREES, ALSO THE MOST PREVALENT FUNGOID AND INSECT BLIGHTS.

Root Fungus *(Lycoperdon gemmatum)*.

This terrible pest may occasionally be met with in all parts of the colony, most frequently in rather dry fern lands. It attacks fruit-trees of every kind, but does not confine itself to trees; ornamental shrubs, gooseberries, currants, box-edging, strawberries, and other herbaceous plants—even meadow-grass, rye-grass, and cocksfoot—are occasionally attacked, while troublesome weeds, such as sheep-sorrel, wireweed, and sow-thistle are not allowed to escape. Chains of hawthorn hedges, pines, oaks, cypresses, and other forest-trees have been killed by its ravages in the Waikato District. In the majority of instances fruit-trees are attacked just when coming into bearing, or when they have been in bearing from two to four years, but trees from ten to fifteen years' growth are not exempt. It is most capricious in the selection of its victims; sometimes single trees in a hawthorn hedge are attacked; at others, two or three together, or every tree, may be killed for a distance of yards. In an orchard a single tree in a row may be visited, or every second or third tree, or the pest may travel the rows obliquely, or pass from one row to another in a most irregular and erratic manner. It is not easy to form an estimate of the loss occasioned by this destructive parasite: tree after tree, apparently in vigorous health and bearing, is suddenly stricken, withers, and dies. In the Hamilton and Cambridge Districts alone the value of the fruit-trees destroyed by this pest during the last four years must be estimated at not less than £4,000.*

* After this report was sent to the press, I was informed by Mr. G. Edgecumbe, Secretary to the Waikato Horticultural Society, that the above sum does not by any means represent the value of fruit-trees destroyed during the period stated.

Even the youngest trees are not exempt from attack, although its greatest ravages are effected amongst trees which are commencing to yield the grower a fair return for his outlay, time, and labour. On witnessing its effects in various localities in the Waikato, I was not surprised to find that it was regarded by the settlers with greater apprehension than any other disease to which fruit-trees are subject, not excepting the peach-blight. The frequent and extensive gaps caused by its ravages, and the certainty with which new plants are attacked when replacements are made, may well dishearten the most enthusiastic cultivator, and cause the gravest fears for the future.

The first indication of the attack of the parasite is afforded by the leaves of the affected plant, which present a starved and drooping appearance; ultimately they become discoloured and fall; but there is no external indication of the cause. On examining the roots they appear flecked with delicate white cottony-looking threads, which permeate the soil in all directions, and frequently form small matted patches resembling the fine mould often seen on stone-fruits. Each thread consists of a delicate tube, and when a number of tubes become matted together they form a kind of web or false tissue; they never coalesce by fusion of their walls so as to form a continuous tissue. They present a similar appearance to mushroom-spawn, and collectively form the mycelium, or vegetative system of the fungus, and extract their nourishment from the plant selected as their host. The mycelium penetrates the woody portion of the root and produces effects of a similar character to those developed by dry-rot *(Merulius lacrymans)*, so that ultimately the stoutest roots may be crumbled to pieces between the finger and thumb; the bark of the collar decays, the decay extends to the trunk, and the tree can be pulled out of the ground with little more difficulty than a common stake.

The erratic manner in which the attacks of the fungus are made may possibly be due to slight variations in the compactness of the surface soil. In all probability the mycelium is able to penetrate soils of a certain texture more easily than others.

In one garden all the plants, chiefly strawberries, within a large irregular patch were first attacked; the mycelium had then attacked the box-edging and worked below the surface of the walk to the opposite side, where it attacked a number of fruit-trees in full bearing.

In some seasons the reproductive system of the fungus is not developed; its vegetative system may permeate spaces many square yards in extent without a single perfect specimen making its appearance. In other seasons the reproductive state is developed in great abundance in certain localities, although in adjacent localities, in which the subterranean state is equally plentiful, there may not be a single reproductive specimen.

The reproductive system is terrestial, and makes its appearance above the surface in the form of small spherical bodies, which break through the soil singly or in clusters of from five to ten. At first they are whitish, fleshy, and apparently homogeneous, but in less than forty-eight hours they assume the form of small puff-balls; the fleshy portion is converted into countless millions of dark-brown spores, resembling extremely fine snuff, and contained in a thin membranous spherical envelope. At length the sphere exhibits a minute aperture at the apex, and the spores escape in myriads, so that, in addition to the indefinite underground extension by means of its vegetative system, the germs of new individuals are distributed broadcast over extensive districts by the lightest breath of air.

It is rarely found to attack trees growing in damp situations. Although I was assured that instances of the kind were known, none came under my observation. In the valuable orchard of Mr. Horn, near Cambridge, not a single tree was attacked on the low ground, but on a dry sloping bank many trees had been killed and others were dying at the date of my visit.

Trees planted on fern-land are especially liable to be attacked by this fungus. In most cases it will be found that fragments of the underground stems of fern have been left in the soil, and when partially decayed have been attacked by the fungus, which, finding a suitable nidus, has speedily covered them with its white thread-like tubes. These mycelial tubes spread through the soil with amazing rapidity, attacking and destroying every plant that comes in their way.

Prevention and Remedy.

When preparing the ground for planting care should be taken to remove fern-stems and decaying wood as completely as possible. Where lime can be procured the soil should be sparingly top-dressed and the dressing turned in some time before planting. Soot-dressings would also prove beneficial. The best remedy that I am able to suggest for this pest would be the saturation of the ground with tar-water, and, where the disease is not too far advanced, the free use of the pruning-knife, cutting away all affected parts unsparingly, then applying a light dressing of Stockholm tar mixed with clay to the wounds. So far as I am aware, the only cultivator who has tested this remedy at present is Mr. Reynolds, of Cambridge. I had the opportunity of examining several trees in his orchard in which decay had commenced at the base of the trunk, and found indications of the arrest of the disease in each case; a new corky growth was forming at the edge of the decayed bark, and the trees were assuming a more healthy appearance.

Unless precautionary measures are taken, planting trees in places where others have been killed by the fungus is simply fatal to the new tree, which may be destroyed the first year. On this point the experience of Mr. Reynolds is conclusive. After having repeatedly replaced diseased trees without a single instance of success, although the soil on the spot was exposed to the air during winter, he saturated the ground with tar-water before planting, and met with complete success in every instance; in no case has a tree treated in this way been attacked by the fungus so far. A single tree planted last year without the previous application of tar-water to the soil was destroyed by the fungus, while those protected by its application are untouched. It is evident therefore that experiments in the application of tar and tar-water may be carried on with the most hopeful prospects of good results.

Pulverized sulphur, mixed with the light soil and worked in amongst the roots, would prove of service, but is less easy of application than tar-water, and would be more expensive. A top-

dressing of soot, or, still better, of soot with a little sulphur, turned in to a full spade's depth, would be attended with excellent results, as would the application of weak-brine solutions. A light top-dressing of gas-lime would also prove of value.

Although I have identified root-fungus as *Lycoperdon gemmatum*, further observation may possibly show that mycelial states of other fungi are mixed with it; but this would not affect the mode of treatment.

APPLE.

American Blight *(Schizoneura lanigera)*.

Unhappily this insect is too generally distributed throughout the colony to need description. Its presence on an infected tree is at once indicated by cottony-looking tufts or patches, which, if neglected, increase in size, the cottony outgrowth often attaining a length of two or three inches. The aphides vary somewhat in colour, but most frequently are black or purplish-black, the young of a faint reddish tinge; the cottony outgrowth is produced from their abdomen; but the process of development has not been fully made out.

From eggs hatched in the spring wingless insects are produced, each of which becomes the mother of a colony, and may be termed the "queen aphis;" she is viviparous, and able to produce several generations of insects without the intervention of the male. The young insects are also viviparous, and, as they are able to commence the work of reproduction when five days old, their rate of increase is enormous. It is no exaggeration to say that a single queen may have many billions of descendants even during her own short lifetime. The sexless insects thus produced resemble the queen, but are of smaller size and more oblong form; they are also of a brown or purplish-brown colour, while the queen is nearly black. Viviparous winged insects are occasionally produced, but they are certainly infrequent in the colony. On the approach of winter perfect-sexed insects are developed, which pair, and in a few days the female deposits her eggs in a crevice of the bark and dies. The eggs remain dormant until the following spring, when new queens are developed.

The sexed individuals have no mouth-apparatus, and are unable to take food, so that their existence is of brief duration. They are of smaller size than their viviparous parent.

In the North Island there appears to be no absolute cessation of the process of viviparous reproduction. Wingless insects are certainly extruded during the winter months, although in reduced numbers.

The woolly aphis is found in crevices of the bark, or at the forks of branches, at the base of suckers, or even in the axils of the leaves. In many cases the roots are attacked and large galls formed, which vary from one to four inches in diameter.

The insect punctures the bark and pumps up the sap, which not only weakens the tree but causes an excessive flow of sap to the affected part, resulting in a diseased warty growth: the bark becomes cracked, and exposes the tissue beneath to further attack, while a new growth forms round the margin of the fissure, thus affording a larger amount of shelter to the insect, and more copious supplies of food to the ever-increasing colony, until at length stem and branches alike are thickly studded with warty excrescences, partially clothed with the white outgrowth so characteristic of American blight.

It has been contended that the aphis attacking the root belongs to another species, which has been described as *Schizoneura pyri*. I have no evidence on this point, and, whatever may be the case in other countries, it has ceased to be of direct practical interest to fruit-growers in this colony, owing to the protective measures adopted of late years. In fact, except in very old orchards, it is not easy to find a tree with the roots attacked by woolly aphis.

Some years ago attention was drawn to the fact that certain varieties of the apple exhibited almost complete immunity from the attacks of woolly aphis, and that their roots were invariably exempt. This blight-resisting power was most strikingly exhibited by the "winter majetin" and "northern spy," which has led to these varieties, with some others, being generally adopted as stocks for other kinds, with the best results. Apples worked on these stocks are never attacked at the roots, and the branches suffer but lightly when compared with trees worked on the crab or on ordinary seedling stocks.

Prevention and Cure.

The bark must be kept clear of moss, lichen, &c., all loose bark should be removed, and the central portion of the head should be kept open by judicious pruning, so as to allow the freest circulation of air, and afford the least amount of cover to the insect.

The most efficient remedy is castor-oil, containing about 2oz. wood-soot to the gallon; this mixture should be applied to the affected parts with a paint-brush. In very bad cases it might be found advisable to make a second application, but I have never known it to fail when properly applied.

Mixtures of caustic potash, sulphur, and oil are excellent. The following has been generally circulated under the instructions of the Hon. the Minister of Lands: "Four pounds of sublimed sulphur in an iron-pot, with enough water to stir conveniently while boiling for twenty minutes; then add 1lb. of caustic potash (Greenbank Company's is the best), previously dissolved, and whilst still hot, and as much colza or other vegetable oil as will make it like a thick paint. Then, when warm, with a large paint-brush, daub it for about the space of a foot round the butt of the stem of the tree. Rain will wash it into the roots, and the oil will tend to preserve its strength for years."

Emulsions of kerosene and milk, or kerosene and soapsuds, are employed in America. Diluted carbolic acid employed as a wash has been highly recommended. Soft-soap, dissolved in boiling water, with the addition of caustic potash and sulphur, forms an excellent remedy. Sulphur and lime used as a whitewash; fish-oil; soft-soap dissolved in boiling water with carbolic acid.

Many other remedies might be mentioned, but, so far as my experience goes, nothing has proved superior to the mixture of castor-oil and soot mentioned at the outset.

Syringing with soapsuds or other liquids has been often advised, but no amount of syringing would be sufficint to clean a badly-infected tree, as it would be impossible to force fluids into all the innumerable chinks and crevices of the diseased outgrowth.

Trees may be protected from American blight and other aphides by planting the common tall nasturtium *(Tropæolum majus)* at the root, and allowing it to ascend the stem. I believe this to be a specific with regard to the root.

Canker-worm *(Ctenopseustis obliquana).*

The larval state of this moth is becoming increasingly troublesome to apple-growers in the Nelson, Marlborough, and Auckland Districts, At Cambridge it is termed the "privet-moth," but I could not learn that it had been observed on that shrub.

The small green caterpillar feeds upon the leaves of the apple, which it glues together by its adhesive threads; it is however, most injurious when it fastens a leaf to the side of the fruit, forming a secure hiding-place from which to attack the epidermis of the apple at its leisure. A considerable amount of injury has already been caused by this insect, and, unless measures are taken to keep it in check, its ravages may be expected to assume larger dimensions.

For a description of the insect and means of prevention, see under "Apricot."

Apple-scale *(Mytilaspis pomorum).*

At the present time this pest is causing serious loss in the Nelson and Canterbury Districts, where, in certain localities, it has led to a diminution in the annual yield. It is, however, not uncommon in other parts of the colony, and it is found to infest not only apples, but pears, plums, hawthorn, and other trees.

In old neglected orchards the mussel-scale is sometimes so abundant as to form a scurfy crust over the bark, the shells secreted by the insects being in contact; usually, however, it is not so densely packed. Badly-infested trees present a starved appearance; neither leaves nor fruit attain their full development.

In the young state the insect is extremely minute, wingless, but possessed of active locomotive powers; the body is oval, furnished with three pairs of legs, a pair of antennæ, a pair of eyes, and curiously-modified mouth-organs adapted for suctorial purposes. The locomotive stage rarely lasts more than a week, when the insect is found to be attached to the epidermis by its suctorial beak, and its metamorphoses commence. It casts off the first coat or pellicle, which it has outgrown, and within two days of becoming stationary commences the formation of its test or shield, which is composed of a secretion produced by the spinnerets on the under surface of the abdominal region, combined with the two coats or pellicles cast off by the insect. The shield is attached to the bark by its margin, but does not attain its full growth until after midsummer, requiring a period of seven weeks for its completion, when the insect is found to have attained its mature state, and to occupy the greater portion of the space protected by the shield, but without being directly attached to it. Having no further use for organs of sight or locomotion, it has thrown off its eyes, three pairs of legs, and its antennæ, with its cast-off coat, and now resembles a minute grub. It commences to deposit eggs, the process occupying about a fortnight, during which time the insect has become reduced to less than one-third of its size at maturity, and occupies the upper portion of the shell, the eggs filling the lower portion. As a rule the eggs are not hatched until the following spring. The male of this species has not been observed.

In America this insect is considered to cause a greater amount of injury than any other, and I believe this to be true in the Nelson District at the present time.

Although numerous remedies have been proposed, it must be confessed that few have proved satisfactory in practice. Many of them require the removal of the scale by rubbing or scraping, a process involving the unnecessary expenditure of a large amount of time and labour, as the insects can be destroyed and the trees kept in a clean condition at a very small cost and with but little trouble.

Castor-oil, containing 2oz. of soot to the gallon, as recommended for American blight, is thoroughly efficient under all conditions when properly applied.

At the School of Agriculture, Lincoln, several hawthorn plants amongst the ornamental trees were so badly attacked by the apple-scale that their bark was completely encrusted, their leaves shrivelled, became discoloured, and fell away without reaching maturity. The bark was lightly washed with the castor-oil mixture, applied with a paint-brush, the result being a complete success: the scale fell away, the bark assumed a healthy appearance, and new leaves were developed within six weeks of the first application. As a matter of precaution a second dressing was applied later in the season, and the trees remained in a healthy state. In planting the experimental orchard a few trees just received from the nurseries were found to be slightly infested with scale and American blight; the parts affected were treated in the same way, and, although the orchard is in a district where infested trees are much too common, a careful examination in the early spring, and the application of the wash to any branch on which scale or aphis had effected a lodgment, was found sufficient to eradicate the pests with very little trouble.

A mixture of kerosene and linseed oil has been recommended, and without doubt would prove

effectual; but, unfortunately, in practice, it has been destructive to the tree. Mr. Budden, Mr. Weisenhavern, and other growers inform me that in Nelson numbers of young trees had been killed by its application, and similar results have been experienced in other places.

Kerosene emulsions have many advocates, but in actual practice I do not find that kerosene has the slightest advantage over castor-oil, while its application to growing vegetable-tissue is certainly attended with risk. The worst effect that I have seen attending the use of castor-oil, when applied in excessive quantities, is the retardation of leaf-development for a few days.

Amongst other applications may be mentioned a mixture of soft-soap and seal-oil; covering with a thin wash of soft-soap and scraping with a wooden knife; lime-water; tobacco-water and sulphur, applied as a wash; covering the affected parts with clay reduced to the consistency of paint, with the addition of oil and sulphur, &c. At present, however, I have not seen any preparation equal in value to the simple mixture of castor-oil and soot.

Green Aphis *(Aphis mali).*

A green aphis, which is occasionally met with on apple-trees, is for the present identified with this species.

I have not met with any mixture in which its presence has been attended with serious results, although the leaves of infested trees are more or less curled backwards so as to afford shelter to the insect.

The green aphis may be readily destroyed by syringing with soapsuds, or even with water, if ejected with sufficient force.

Strong tobacco-water is an excellent wash for trees infested by aphides. It is made by pouring a gallon of boiling water over four ounces of tobacco and allowing it to stand for a few hours. A little soft-soap dissolved in the infusion would be beneficial.

Tobacco of sufficiently good quality to serve as an insecticide may be grown in any part of New Zealand.

In Europe and America several successive seasons may elapse without any great amount of injury being effected by *Aphis mali*, but in other seasons the insect becomes diffused with such rapidity that the leaves and crop are destroyed.

Codlin-moth *(Carpocapsa pomonella).*

This pest is increasing in many parts of the colony, but at present is not generally distributed. It is most destructive in the Provincial Districts of Canterbury, Marlborough, and Nelson, but is not confined to them; it is known in Westland, Wellington, and in several parts of the Auckland District. It was observed in the Auckland District about twelve years ago, and in Nelson about eight. Instances of its importation from Tasmania and California in affected fruit are occasionally reported, and in all probability have been of not unfrequent occurrence.

The moth is about three-quarters of an inch across when its wings are fully expanded, but the individuals vary in size to a considerable extent; the wings are grey, with dark transverse lines and black markings.

The eggs are deposited singly on the apex of the ovary when the apple is in flower, or on the crown of the young fruit at a later season; the caterpillar is hatched in a few days and eats its way to the central portion of the ovary, and at first does not attack the covering which immediately protects the young seed; it extends its burrow until it perforates the epidermis of the fruit, so that a somewhat tortuous gallery is formed, admitting air freely and facilitating the discharge of excreta. The caterpillar now returns to the core of the apple, pierces the cartilaginous covering and gains access to the seeds (pips), upon which it feeds until the apple falls, when it emerges from the fruit and ascends the trunk of the tree, taking shelter in a crevice of the bark, or beneath a tuft of lichen or moss, or below the junction of a branch with the trunk, &c., having passed fully three weeks in the caterpillar-stage. Having found a convenient resting-place it enters the chrysalis-stage, which in the early part of the season is of brief duration, the moth emerging to deposit its eggs as already described, so that two or even three generations may be developed in one season.

Caterpillars leaving the fruit late in the season remain in the dormant stage during the winter, the perfect insect making its appearance the following spring.

Prevention and Cure.

All loose bark should be removed, moss or lichen should be scraped off. Loose growth of every kind should be cut away so as to afford the least possible amount of shelter for the caterpillar after it leaves the fruit, and expose it for a longer period to the attacks of birds.

The period at which the insect may be most easily destroyed is during the caterpillar-stage, when advantage may be taken of its habit of ascending the trunk to capture large numbers. Bands of canvas, calico, or even stout paper, three to five inches wide, are attached round the stem in such a way that the upper margin fits tightly all round, while the lower margin is sufficiently loose to allow the caterpillar to creep beneath it without difficulty; the insect readily takes possession of the shelter afforded by the band, and, secreting a light web, enters upon its dormant stage. The bands should be examined once a week and the caterpillar destroyed: usually several insects will be found under each band.

Ropes of hay or straw, dipped in a mixture of tar and oil, and laid on the ground so as to surround the trunk without touching it, would doubtless prevent the caterpillar from gaining access to the tree, but would do nothing towards destroying it.

All fallen fruit should be promptly collected and destroyed before the caterpillars have time to emerge.

LEAF-CHAFER.

I was informed that a small brown beetle frequently attacked the leaf of the apple in several districts during the early summer months, and in the Waikato I saw large quantities of apples disfigured during the early stages of growth, and often curiously warted or even distorted, not improbably by the same beetle; but I was unable to obtain specimens of the insect.

In the North it was spoken of as the "Maori bug," but this name is misleading, being commonly applied to the *karamu*, so well known on account of the unpleasant odour which it emits when touched.

GRASS-GRUB *(Odontria zealandica)*.

See under "Olive," page 17.

APPLE-BLOSSOM WEEVIL *(Anthonomus pomorum)*.

At present this troublesome beetle has been noticed only in a single locality—the experimental orchard at the School of Agriculture, Lincoln, where it was observed in November last that all the blossoms on a single tree had been destroyed. In all probability it will prove to be not infrequent, and in late seasons cause much injury if allowed to remain unchecked.

The first indication of the attack of this insect is afforded by the condition of the flower-buds, which often exhibit a healthy and luxuriant appearance almost up to the point of full expansion, when further development is arrested, the petals wither and become matted together, and the prospect of fruit is entirely destroyed for the season. On examination it is found that every flower-bud exhibits a minute perforation, and that the stamens and pistils have been destroyed by a minute white grub one-eighth of an inch in length.

As soon as the buds are sufficiently developed for the white colour of the petals to be distinguished, they are perforated by the female insect, and an egg is deposited; the egg is hatched in about a week, and the grub commences to destroy the essential parts of the flower; the petals wither and become matted together, and as soon as the food-supply is exhausted the grub enters into the pupa-state, which is passed in the withered flower. The perfect weevil is developed from the pupa in less than a month from the time at which the eggs were deposited, and feeds on the leaves for the remainder of the season. On the approach of winter it takes shelter under stones or in crevices of the soil, or amongst loose bark and moss. The perfect female is less than an eighth of an inch in length, and is furnished with a long curved proboscis. She is reddish-brown in colour, with light patches behind the head.

Eggs cease to be deposited as soon as the flowers are fully expanded, so that the season during which this inconspicuous pest can work mischief is of the briefest, but it is unfortunately sufficient to enable it to destroy all prospect of a crop for the season. The female, being wingless and passing the winter season at the foot of the tree, may be prevented from ascending by tying narrow strips of brown paper saturated on the outside with tar mixed with a little fish-oil round the stem of the tree. These bands should be tightly attached round the upper margin, and the oil should be sufficient to prevent the tar from becoming dry during the period necessary for the expansion of the flowers.

Should the weevils not be observed until the buds are attacked, syringe freely with a strong solution of caustic potash; this will kill the grubs and prevent the development of newly-laid eggs.

As the period of flowering is necessarily prolonged by cloudy weather, it follows that the insect has a longer period in which to deposit its eggs, and therefore requires to be more closely watched.

APRICOT.

SCALE.

THE apricot is occasionally attacked by at least two species of bark-scale, for which the best remedy is the mixture of castor-oil and soot, with the addition of soapsuds.

For fuller particulars, see under "Apple-scale," page 7 *ante*.

CANKER-WORM *(Ctenopseustis obliquana)*.

The caterpillar of this moth is very injurious to the apricot, feeding on the leaves, which it fastens together by viscid threads, and attaches them to the ripening fruit, when it feeds upon the epidermis and under-surface, rendering the affected apricots unfit for market.

I was informed that the caterpillar makes its first appearance in December or January, and continues feeding for nearly three months on the leaves of the apricot, apple, and plum, but doing the greatest injury to the apricot. The caterpillar may be found in the orchard as late as the middle of May.

It has been mistaken for the European winter-moth *(Geometra brumata)*, but that species has not been found in New Zealand, and in Europe attains its perfect state during the winter months, November and December. The females have only abortive wings.

The caterpillar of the canker-worm moth is about three-quarters of an inch in length, and of a pale green tint, yellowish on the side, head black or dark brown. The moth is about five-eighths of an inch long, with dull-brown wings, showing patches of a deeper tint. The caterpillar enters the pupa-stage about May.

I have observed the insect in the larval state only, and do not feel absolutely certain as to the correctness of the identification, which is based upon a solitary specimen of the moth, for which I am indebted to Mr. P. Swanwick, of Picton.

Infested trees may be syringed with a weak solution of caustic potash; or fires of weeds, &c., may be made underneath the trees so as to stupify the caterpillars or drive them away. Leaves spun together by the threads of the insect should be removed as soon as observed, care being taken to destroy the caterpillar.

A small spider destroys large numbers by depositing its eggs in the body of the larvæ.

The caterpillars of several moths are confused by fruit-growers under the general term "Canker-worm," but the perfect state has only been observed in the present instance.

CHERRY.

Cherry-aphis *(Myzus cerasi)*.

For treatment see "Apple-aphis," page 8 *ante*.

Scale.

For treatment, see "Apple-scale," page 7 *ante*.

Slug-leech.

For description and treatment, see under "Pear," page 21.

Red Spider.

For description and treatment, see under "Hop," page 11.

CURRANT.

Borer *(Æmona hirta)*.

This troublesome insect is sometimes found infesting the currant, occasionally in such excessive numbers as to cause death.

When the insects are not numerous, affected branches may be cut off; but, when the trees are badly affected, they should be rooted up and burned at once.

For a more complete account, see under "Lemon," page 13.

Caterpillar.

The larva of a small moth, not yet identified, feeds upon the leaves of the currant. Its habits are similar to those of the canker-worm of the apricot, to which reference may be made for treatment. See page 9 *ante*.

GOOSEBERRY.

Borer *(Æmona hirta)*.

The gooseberry as well as the currant is infested by this pest, and its ravages are sometimes fatally destructive. Mr. A. T. Urquhart informs me that trees which bore heavy crops last season are now dead. The gooseberry and currant alike appear to have less power of resistance than the lemon; perhaps on account of their smaller size and short period of duration.

For treatment, see under "Lemon," page 13.

Scale.

Two species of scale-insects are found on the gooseberry, sometimes in large numbers.

For treatment, see under "Apple-scale," page 7 *ante*.

CATERPILLAR.

The gooseberry is also attacked by a caterpillar bearing a strong resemblance to the species which infests the currant, but further information is required before it can be identified.

It may be treated in a similar manner.

HOP.

RED SPIDER *(Tetranychus telarius)*.

THIS minute spinning-mite is a troublesome pest not only to the hop but to the apple and other fruit-trees in many parts of the colony. I have observed it in all the districts except Taranaki, Westland, and Otago, and it would doubtless be found to occur in the first and last if searched for.

Unless occurring in large numbers it may easily pass unnoticed by a casual observer. In the autumn months it forms dense reddish or brownish patches on the stem and leaves, and as winter approaches seeks the shelter of crevices, especially near the base of the plant. It increases rapidly during periods of drought, but is rarely able to cause serious injury in moist seasons. Its structure cannot be made out without the assistance of a pocket-lens, when the minute speck is found to consist of an oval body, differing from that of an insect in having four pairs of legs, two pointing forwards and two backwards; it also has a suctorial mouth and a short pair of antennæ. Plants infested by this mite are characterized by curled, shrivelled leaves, which assume a brown or rusty hue, changing to a dull yellow before they fall. On examination the under-surface of the leaves is found to be covered with a web, which affords shelter to the mite.

The eggs are thickly attached to the delicate threads of the web, and only require about eight days before hatching, so that new colonies are formed with great rapidity.

Prevention and Remedy.

Frequent syringing with cold water is sufficient to prevent this troublesome pest from becoming established. Dusting sulphur over infested trees is an effectual remedy.

Mr. Goodhue's preparation of sulphur and lime, used as a thin liquid and applied with the syringe or garden-engine, is excellent and inexpensive; or the powder may be used, although it would be less easy of application, and for this purpose less effective. A thin solution of soft-soap containing sulphur might be used with advantage. Sulphur and lime might be dusted over the surface of the ground at the base of the stem.

In exceptionally-bad cases it may be found advisable to wash the trunk and main branches of affected fruit-trees with a thin solution of soft-soap containing sulphur and lime.

In late, dry seasons the hop suffers severely from the ravages of this pest, the crop being deteriorated in quality and diminished in quantity.

The hop-aphis *(Phorodon humuli)* has not been observed in New Zealand.

LEMON, ORANGE, CITRON, ETC.

1. FOOT-ROT.

THIS disease is attended with more serious results than any to which the lemon and citron are liable in this colony. The first indication is afforded by the leaves turning yellow and falling; in a short time the branches are partially denuded, and, as the luxuriant growth of young shoots is severely checked, the tree assumes a straggling habit. At the same time the affected tree usually produces flowers in profusion, and the flowers develop fruit. Although diseased, it may continue in a fruit-bearing condition for several years, and even carry heavy crops; but with the progress of the disease the fruit becomes gradually reduced in size, and at length the power of maturation is lost. In the last stage the tree becomes almost leafless, yet still develops flowers, although the pollen is usually abortive, and the ovaries do not become fertilized. It may linger in this condition for several years.

The disease commences with the decay of the minute fibrils of the root; the fibres are next affected, and the decay extends to the larger arms; the epidermis peels off in flakes or rots away, when the decay spreads to the woody parts, and, after attacking the bark of the collar, makes its appearance above ground, ascending the stem for a foot or more, the decaying bark emitting a nauseous odour, and falling away in pieces; even before it falls, and while apparently sound, it may often be rubbed off by the fingers. The bark is sometimes attacked by fungi, but their inroads are simply due to the progress of the disease, which has prepared a suitable nidus for the parasite, and must not be mistaken for the cause.*

If the decay of the bark is confined to one side of the stem the plant may continue to produce fruit for years, but if the entire circumference is affected, so that the outer layers of tissue are destroyed, death speedily ensues.

* In this stage I have seen a trunk clothed on one side with a dense growth of *Hirneola polytricha*, the fungus so much in demand amongst the Chinese.

Healthy trees produce masses of matted rootlets immediately beneath the surface of the soil; every minute fibril being clothed with root-hairs near the tip. In diseased trees the branches of the root are almost naked, but few fibrils having escaped decay, and they are so much affected as to be almost destitute of root hairs.

Causes.

Foot-rot is chiefly caused by the rootlets penetrating into a cold retentive subsoil; deep planting; earthing-up, whether with wood-ashes, stable-manure, or with earth; excessive manuring, &c.; in some cases by excessive autumn pruning, leading to a late growth, and consequent development of unripened wood. Young plants that have been kept so long in pots as to become "pot-bound" are peculiarly liable to be attacked.

Prevention and Cure.

Excessive autumn pruning, the application of manure late in the season, or any cause tending to stimulate root-action shortly before the approach of winter must be avoided, on account of the risk attending a sudden arrest of growth.*

The degree to which remedial measures may fairly be expected to prove successful must depend to some extent upon the stage of the disease; as a general rule, so long as decay has not encircled the stem, recovery may be hoped for. The soil must be thoroughly drained, and, if of a retentive character, properly worked before replanting. All unsound portions of the root must be cut away, and all traces of decay removed; in cloudy weather the roots may be left partially exposed for a few days; afterwards covered with leaf-mould or with light alluvial soil. The decayed bark must be pared away in such a manner as not to wound the sound portion more than can be avoided. Frequent application of tar-water to the root and stem will be found beneficial in all except extreme cases. A light top-dressing of lime mixed with a little sulphur would probably prove of benefit.

This disease is most frequent among trees growing in cold subsoils; it is rare on open volcanic soils or where the trees have been surface-planted. It attacks the lemon and citron more frequently than the orange, and its effects upon the former are more severe than upon the latter. The shaddock appears to be exempt from its attack, but the lime sometimes suffers severely.

In some cases a gummy secretion is exuded by the affected parts of the stem during the earlier stage of the disease, and ceasing with the decay of the bark; this constitutes the disease termed "lagrima," but I am unable to draw a distinction between the two.

ROOT-FUNGUS.

See *ante*, page 4.

BLACK BLIGHT, OR LEMON SMUT *(Capnodium australe,* n. sp.).

I have no hesitation in referring this fungus to *Capnodium*, but am unable to identify it with any species of which I possess descriptions; it is therefore provisionally distinguished as *Capnodium australe* for convenience of reference.

The fungus forms a black film on the surface of the leaves and twigs, and usually develops short, erect, excessively-branched filaments from one-tenth to one-quarter of an inch in length, sometimes in such abundance as to form a velvety surface, but the general appearance of trees clothed with this sooty-coloured parasite is simply disgusting.

The fungus acts injuriously by closing the orifices of the air-passages, and preventing the direct action of light, so that the leaves are unable to discharge their functions.

By some cultivators it is said to be the excreta of the large white scale *(Icerya purchasi)*; it is, however, a true fungus, although frequently found growing on trees infected by scale, aphis, or other homopterous insects. It certainly assumes its most luxuriant growth on twigs or leaves coated with the honey-dew secreted by many of these insects, but, so far as my observation serves, the connection is not invariable.

Trees infested with scale and aphides are not always infested with the fungus, and trees affected by the fungus are not invariably attacked by Homoptera.

That it has no necessary connection with Icerya is apparent from the fact that orange- and lemon-trees were observed to be infested with the parasite at least ten or twelve years before the introduction of Icerya into the colony.

There is a curious similarity of growth between our plant and its near relative *Antennaria scoriadea*, a fungus also of a velvety, sooty appearance, but of much larger size. Both plants are found on trees infested by Homoptera, and both are found on trees apparently destitute of these insects; the Antennaria is however found occasionally on bog mosses *(Sphagnum)*, which, so far as I am aware, are never infested by scale or aphides.

It has been suggested that, as the fungus is almost invariably connected with the occurrence of scale or aphis, it is superfluous to treat it as a separate pest; if the insect be destroyed, the fungus will cease to exist. While fully admitting the frequency of the association, I am unable to give full assent to this view. I find instances in which the fungus is not directly associated with insects, and have seen trees sparingly attacked by scale, but having the leaves so excessively infested with

* At the Bay of Islands, in June last, oranges and lemons in active growth were severely cut by frost, while trees which had completed the season's growth were uninjured.

fungus that it was not easy to see in what way the small quantity of honey-dew secreted by the insects could have caused the excessive abundance of the plant. Another point is worthy of consideration: even should it be proved that the fungus can only originate upon leaves covered with honey-dew, it does not necessarily follow that it is unable to maintain its existence without continuous supplies of the secretion.

The closely allied *Antennaria*, to which reference has already been made, sometimes starts into existence on plants growing under the shade of trees infested by scale-insects, and consequently exposed to the drip of falling honey-dew, but it has been known to exist long after the removal of the overshadowing trees, and consequently of the insect-secretion also.

Oranges or lemons picked from trees affected by fungus should be carefully wiped before being packed for transit by sea. This precaution is of some importance, as the warm damp atmosphere of a steamer's hold would facilitate the germination of the fungus-spores, and the fruit might arrive at its destination in an unsaleable condition.

The fungus may be destroyed by dusting the affected leaves with sulphur, or with a mixture of sulphur and lime, either of which would also be found beneficial in assisting to dislodge insect-pests also.

Lemon-tree Borer (*Æmona hirta*).

All citraceous trees are subject to the attacks of boring insects, and in some districts receive excessive injuries from these pests. Occasionally the stem and main branches may be found completely riddled, the injuries sometimes extending below the surface of the ground, and resulting in the death of the tree.

My observations on the insect were exclusively restricted to its larval condition, the only state which I was able to obtain during the months of June and July, although numbers of affected trees were examined. For its identification I am indebted to A. T. Urquhart, Esq., of the Karaka, who has recently (27th August) forwarded specimens in the pupa-state, one of which was sufficiently developed to enable him to identify it as the *Æmona hirta* of Captain Broun's "Manual of the New Zealand Coleoptera." He informs me that he has observed the beetle for several years in connection with the fertilization of the Yucca, but its identity with the lemon-tree borer has not hitherto been suspected.

In trees affected by the borer a few of the young branchlets present a withered appearance, the bark for an inch or more below the tip shrivels and turns brown, the leaves fall, and in a short time the twig breaks; at the point of fracture a few grains of wood-dust may be discovered, and on splitting the branchlet longitudinally below the fracture a small gallery will be found excavated in a downward direction, and containing the larval insect ensconced at or near its lower extremity.

The perfect female insect punctures the branchlet a short distance below the apex and deposits an egg; on being hatched the grub commences to bore its way downwards, taking advantage of the central pith. On reaching the base of the twig it continues its excavations into the branch, at the same time increasing the diameter of its gallery, and at intervals forming shallow expansions to the right and left. At length it reaches a stout branch, or possibly the main stem, when it bores through the bark, and after a longer or shorter period enters upon its quiescent stage, the exact duration of which has not been ascertained.

The largest specimens of the larval state that have come under my notice are about an inch and a quarter in length, and of a yellowish-white colour. The segments are thirteen in number, somewhat keeled or ridged; the mouth is small and slightly sunk in the head. Each of the three thoracic segments carries a pair of minute pointed feet turned outwards, and all the segments are more or less clothed with short, rigid, scattered hairs.

The galleries vary greatly in length, the longest that I was able to trace uninteruptedly was under two feet, the average being from nine to fifteen inches, the greatest diameter was three-eighths of an inch. I was assured by one or two observers that the grub invariably makes its way to the main stem; this view, however, cannot be maintained, as the apertures by which the beetle makes its exit may frequently be observed on the branches. The sudden increase in the diameter of the gallery as the borer passes from the branchlet into the adjacent branch is very striking; it is often marked by a small pellet of curved woody fibres, such as may be found near the shallow lateral expansions already mentioned. In rare instances the gallery is driven upwards, and the larva has the power of moving along its gallery either upwards or downwards with some degree of rapidity, the movements being doubtless facilitated by the short stiff hairs which are scattered over the segments.

The perfect insect is from five- to seven-eighths of an inch in length, with a narrow body; the head is partially clothed with yellow hairs; antennæ as long as the body, eleven-jointed, the terminal joints hairy; body cylindrical or slightly flattened; wing-cases reddish brown, somewhat truncate.

The duration of the larval and pupa states has not been ascertained at present. In all probability eggs are deposited from December to April, and require but a short time for hatching; the grub certainly remains in the trunk through the winter season, not emerging before September at the earliest, but whether it remains there more than one season can only be ascertained by further observation. Mr. Urquhart, under date the 16th August, states, "Some galleries end in an enlargement or chamber communicating externally with a small breathing-hole." This would indicate that boring operations in these cases were not completed, although many insects had attained the pupa-stage. It is probable that the lemon is infested by more than one species of borer. Two instances have come under my notice in which the gallery was driven transversely nearly through the branch, and the woody tissue excavated from each side without interfering with the bark, so that a shallow circular chamber was formed about three-quarters of an inch in diameter and one-tenth of an inch in height, but the insect escaped observation. A branch injured in this way is broken even by light winds.

Prevention and Cure.

In all probability the most efficient way of meeting the inroads of this pest will be by preventing the deposition of eggs, but at present the perfect beetle and its habits are quite unknown, so that further observation is necessary.

All wounds should as far as possible be covered with a thin film of tar or some other substance calculated to prevent the deposition of eggs. Branches attacked by the insect should be at once removed and destroyed, care being taken to cut below the extremity of the burrow.

Probing the galleries with a fine-pointed wire and perforating the larvæ would be found effective, and might easily be carried out when the insects are few in number. Mr. Campbell, manager to W. J. Hurst, Esq., M.H.R., Hurstmere, injects soft-soap dissolved in boiling water containing a little carbolic acid into the galleries by means of a syringe with a fine nozzle. He informed me that this mixture dissolved the larvæ, so that the outflow presented a milky appearance. A weak solution of caustic potash would prove equally effective. Possibly the perfect insects might be captured by suspending pots containing treacle or treacle and honey amongst the branches, or even by smearing treacle on loose cloths.

Trees extensively infested by borer present a somewhat straggly appearance, the branches being broken and partially denuded of leaves; still fruit is produced in abundance until the energy of the tree is exhausted. The least amount of harm is caused when the boring is confined to the centre of a stout branch or the main stem, the greatest when the excavations are made immediately beneath the bark. When the excavations are numerous branches are continually broken off by the wind.

WHITE SCALE *(Icerya purchasi).*

This unwelcome intruder was first observed by Dr. Purchas on kangaroo acacia, in the cemetery gully, Auckland, in 1876, and the female insect was described by Mr. W. M. Maskell in 1878 as *Icerya purchasi.* It was supposed to have been introduced with wattle from Australia; but it is not a native of that continent, and in all probability has come to our shores with imported citrads from the Fiji Islands or California. Unhappily it is now found infesting citraceous plants from the Bay of Islands to Nelson. In some localities it is plentiful on wattles; less frequent on furze, manuka, &c.; more rarely still it may be found on the apple, plum, and peach; but I have never seen it in quantity on either. It usually occurs in scattered or linear masses on the twigs and small branches of the lemon, citron, &c., and on the under-surface of leaves. Not infrequently it forms superficial patches, covering two or three square inches on the trunk.

The mature female insect is fully one-quarter of an inch in length. In the young state it is of a reddish-brown colour, and is furnished with a pair of short antennæ, a pair of eyes, a short beak adapted for piercing the epidermis of plants and extracting their juices, and three pairs of short legs. In this state it is oval in shape, and exhibits a certain amount of activity; in a few days the reddish-brown colour is obscured by a flexuous, cottony outgrowth, and the oval shape is partially lost. Minute tufts of black hairs are arranged along the lower margin of the body. The insect becomes attached to the epidermis by its suctorial beak and loses the power of locomotion. It now forms its nest between the abdomen and the surface of the twig in such a way that the abdomen is gradually elevated and the space beneath proportionally enlarged for the reception of eggs, which are deposited to the number of fifty or more, and are hatched in a few days. I have not seen the male insect, bnt have been assured that it is not uncommon in the spring, and exhibits considerable activity, the slightest movement of a branch being sufficient to start a number of them on the wing.

Trees attacked by white scale present a most unattractive appearance; but, unless suffering from foot-rot, borer, or other plagues, do not appear to become so much exhausted as might be expected from the vast numbers of the insect. No instances of fatal results from its ravages have come under my notice.

Prevention and Cure.

Young trees should be carefully examined before planting, in order to remove any scale that may have attacked them; dipping them in a solution of caustic potash and sulphur would be an excellent safeguard. After planting, the trees should be frequently inspected, so that the first appearance of the pest may be detected, and prompt measures taken for it destruction. In this way it may be prevented from establishing itself at but little cost. Should the orchard become thoroughly infected, the extirpation of the insect would involve a considerable expenditure of time and labour. All affected branches should be promptly destroyed.

The most effective means of destroying this pest is to syringe freely with a solution of caustic potash. After the publication of my memorandum on the diseases of lemons, this remedy was tried by Mr. B. Dawson, gardener to S. Morrin, Esq., of Remuera, with the best results, and will, I am satisfied, prove satisfactory in all cases. It will rarely need more than a second application.

Washing the effected parts with boiling water is one of the most effective remedies that can be adopted, but is scarcely applicable on a large scale, and is altogether inapplicable to young shoots during the period of active growth. Syringing or washing the tree with a thin solution of soft-soap, painting the affected parts with castor-oil containing a small quantity of soot, would be found of the greatest value.

Mr. Maskell has kindly drawn my attention to kerosene made into an emulsion with soapsuds, which in America is considered the best remedy for scale of all kinds. I have elsewhere stated my reasons for preferring castor-oil to kerosene as an insecticide.

All preparations containing oil must be applied to citraceous plants with the greatest care and with a light hand. Castor-oil is an insecticide of great value, and, properly applied, is not injurious

to vegetable tissue. I am, however, confident that, on account of its thorough efficiency, cleanliness, and the ease with which it can be applied, weak solutions of caustic potash will supersede all other applications recommended for the destruction of Icerya, which, owing to its rapid increase, must be looked upon as one of the most dangerous enemies which the lemon-grower has to encounter.

Leaf-scale.
Olive-scale *(Lecanium oleæ).*
Orange-scale *(Lecanium hesperidum).*
Sandal-wood-scale *(Diaspis santali).*

In addition to the soft-bodied white scale (*Icerya purchasi*), citraceous trees are infested by several scale-insects, more or less protected by tests or shields, beneath which they live, and which are attached to the epidermis of the plant by their margins, in a similar manner to the apple-scale already described. The most common of these are the species whose names are given above. Their chief characteristics may be briefly stated.

The orange-scale is found on the twigs and on both surfaces of the leaves. It is oval in outline, and about one-fifth of an inch in length. The shield is dark brown and somewhat rugose. It is sometimes termed the tortoise-scale, and is found also on holly, Portugal laurel, and other trees.

The olive-scale forms minute brown or blackish cushion-like bodies on the twigs and leaves. It is very common on citraceous trees, but especially on the mandarin orange, of which it sometimes takes complete possession. Like the preceding, it is naturalized in New Zealand, and is commonly called "black scale." It is also found on the plum and other cultivated fruit-trees, as well as on several native plants.

The sandalwood-scale is found on the native maire *(Fusanus cunninghamii),* but appears to be extending its attacks to cultivated trees, and, amongst others, to citraceous trees. It is much smaller than either of the preceding, and is chiefly confined to the twigs and branches, on which it forms a scurfy crust.

The injury effected by these pests cannot be compared with that caused by the white scale. Unfortunately they are increasing rapidly, and, unless kept in check, may cause as great a loss amongst oranges and lemons as their near ally, the mussel-scale, causes amongst apples.

The castor-oil and soot mixture, recommended for the apple-scale, will be found equally effective in destroying the hard scale infesting the orange.

Syringing with a solution of caustic potash and sulphur would prove of great benefit, but less effectual than the above.

Orange-aphis.

At present I am unable to identify the species which infests the orange and lemon.

In some seasons it attacks the young shoots in myriads. At a short distance the leaves on the upper portion of the branches appear to be suffering from black blight, which, however, is rarely seen on young leaves, its attacks being mostly confined to those fully developed.

The colour of the insect is brownish black. Winged males and females may be found associated with wingless females in June and July, as well as during the autumn months. It is most destructive during the early spring and the late autumn, but may be found at all periods of the year.

It is readily destroyed by syringing with soapsuds, tobacco-water, or with soft-soap dissolved in hot water, or the leaves may be dusted with lime or sulphur. Heavy rain will often clean trees badly infested with aphides.

Phasmids *(Bacillus hookeri). (Acanthoderus spiniger.)*

The "walking-stick" insect occasionally attacks the young shoots of citraceous plants, and when numerous effect a considerable amount of injury in a short time.

Affected trees may be freely dusted with lime or sulphur, or syringed with soapsuds, &c.

Cicada, etc. *(Cicada cingulata).*

The cicada frequently injures the smaller branches by forming a longitudinal groove on the surface, and depositing its eggs at the base. Its habits have not been fully observed, but, in all probability, the larvæ descend to the ground and attack the roots of certain plants, not necessarily of the orange itself. This can only be ascertained by further observation.

At present its injurious effects appear to be restricted to the wounds caused by the female previous to the deposition of eggs, and which often lead to the injured branch being broken by the wind.

Crickets are also said to cause injury to the roots by gnawing the epidermis, but no instance of this kind came under my observation. The larvæ may readily attack the roots of oranges amongst other plants. In their perfect state crickets may be destroyed by mixing a small quantity of phosphorus with flour, and placing it in their haunts. The larval state may be treated in the same way as the grass-grub (see "Olive").

The New Zealand Mantis is also stated to be injurious; but nothing is certainly known about it at present, and the insect itself is comparatively rare.

Caterpillars.

The larvæ of several small moths are frequently found feeding on the young leaves, but at present none of them are known in the perfect state so as to allow of their identification. Their ravages are seldom of a serious character; but any great increase in their numbers would be attended with a corresponding increase in the amount of injury effected by them.

Syringing with strong tobacco-water, or with a solution of caustic potash containing sulphur, may be applied where necessary.

Grass-grub *(Odontria Zealandia)*.

The grass-grub attacks the roots of citraceous trees as well as others, and when in large numbers causes a considerable amount of injury in a brief period. The larvæ feed upon the root-fibrils and epidermis of the more tender portions of the root, so that the tree is unable to procure a proper amout of nourishment, its growth is arrested, and it is unable to mature fruit. The perfect insect has not been observed to attack the foliage, as in the apple.

For a more complete account of this insect and for remedies, see under "Olive."

Thrip.

These minute insects may sometimes be found on neglected trees in vast numbers, especially when the trees are growing in dark damp situations. Careful pruning and the removal of all superfluous growth from the centre of the tree will do much towards preventing their attacks. Frequent syringing with a powerful syringe or garden-engine will usually be found sufficient to drive them away. Where they have been established for any length of time, it may be advisable to add a weak solution of caustic potash with sulphur.

Woodlice.

These well-known pests are occasionally troublesome to the orange-grower, but their ravages are rarely of a serious character. They are usually found at the base of the stem or in the forks of branches. Saturating the soil at the base of the trunk with a thin solution of lime and sulphur will be found beneficial, or Goodhue's powder may be dusted over their habitat.

Lichen.

The trunks and branches of neglected trees are sometimes covered with a strong growth of lichen (chiefly *Ramalina fastigiata*, &c.), which is most troublesome when the trees are growing in a hard or unbroken subsoil.

When this is the case every effort should be made to improve the quality of the soil, and to faciltate vigorous growth. The bark should be scraped and the lichen removed. Amongst other evil effects, epiphytic growths on the bark afford shelter to noxious insects.

Snail *(Helix aspersa)*.

This introduced mollusc is a dangerous enemy to all kinds of citraceous plants, and is frequently found infesting the trees in large numbers. During the winter season snails collect in large masses in the forks of branches, &c.; sometimes as many as from thirty to fifty may be found together. The eggs are laid in masses from fifty to eighty on or immediately beneath the surface of the soil, or under bark or wood lying on the ground.

Snails feed on the epidermis of the young branches and leaves, causing the growth to be checked; they are especially fond of the young fruit, and reduce its value for market by disfiguring it to a great extent. The eggs and shells may be easily collected by hand, and will form a welcome addition to the food-supply of poultry, &c.

Citraceous trees, especially the small-leaved oranges, if neglected, are liable to decay of the branches, sometimes to a considerable extent: the leaves fall, the branch turns brown and decays. This is sometimes considered a special form of disease, and termed "die-back." It is, however, simply caused by neglect of pruning, especially when the trees are planted too close together; it is rarely seen in trees which receive proper attention.

The minute mite which causes the disease known as "orange-rust" has not been observed in the colony, so far as I am aware.

ON THE BEST STOCKS FOR ORANGES, LEMONS, ETC.

Orange-growers in New Zealand are not generally alive to the importance of selecting suitable stocks, and of planting only budded or grafted trees. In many cases stocks are completely discarded, the plants being either raised from seed or propagated by layers. When a stock is called into requisition, the lemon is usually selected on account of its rapid growth and early fruiting. It is, however, the least durable of all, on account of its liability to foot-rot and other diseases; so that it is no matter for surprise to find its general adoption is everywhere leading to considerable loss and disappointment.

It is not unfrequently asserted that the climate of Auckland is unsuitable for the production of oranges of good quality. I am convinced that this statement derives its chief support from the inferior quality of most of the fruit produced by trees raised from seed. It is most unwise to rely upon seedling trees producing fruit equal to that of the parent. Rarely one may be found equal or even superior, but the great majority will prove of but low quality. All cultivated fruits exhibit a strong tendency to revert to their original state, and when of arboreal habit can only be kept of good quality and true to their kind by working scions from proved varieties on suitable stocks.

The bitter orange *(Citrus Bigaradia)* is unquestionably the best stock for general use, but it has the disadvantage of being of slow growth.

Under these circumstances it may prove advantageous to test the value of the indigenous Australian species as stocks for the ordinary cultivated kinds. *Citrus australis* is a strong-growing species, attaining the height of thirty feet; it is a native of Queensland. *C. australasica* is found in Queensland and New South Wales, extending to the Clarence and Richmond Rivers. It will probably prove the hardier of the two. In all probability, there would be but little difficulty in procuring seeds or young plants of either.

The following species of Citrus are generally recognized by those botanists who have paid attention to the genus:—

1. *C. medica*, Lin. The Citron.
2. *C. Limonum*, Risso. The Lemon.
   - " var., *Lumia*. The Sweet lemon.
   - " var., *acida*. The Lime.
   - " var., *Limetta*. The Sweet lime.
3. *C. aurantium*, Lin. The Sweet orange.
   - " var., *nobilis*. The Mandarin orange.
4. *C. Bigaradia*, Risso. The Seville orange.
   - " var., *Bergamia*. The Bergamot orange.
5. *C. decumana*, Willd. The Shaddock.
6. *C. australis*, Planch. Native orange of Australia.
7. *C. australasica*, F. Muell. Native orange of Australia.

All the forms placed as varieties are considered distinct species by some authors.

MULBERRY.

So far as I am aware, the mulberry is attacked only by a single insect capable of inflicting injuries of a serious character, a species of borer, which excavates galleries in the young shoots and branches, causing the affected tree to present a scrubby appearance, owing to the partial arrest of growth. The injuries were observed in July; at present, I have been unable to secure specimens of the insect in any stage.

OLIVE.

Scale *(Lecanium oleæ)*.

The olive is frequently attacked by the black scale, which forms cushion-like bodies on the twigs and leaves, sometimes in great profusion.

The castor-oil and soot mixture recommended for apple-scale will extirpate the pest with but little trouble. Syringing with dissolved soft-soap containing a little lime and sulphur would be attended with excellent results.

Grass-grub *(Odontria zealandia)*.

The roots of the olive as well as other fruit-trees are liable to the attacks of the grass-grub, which, although usually feeding upon the roots of grasses, has of late years developed a voracious taste for all kinds of roots, so that in localities where it is numerous very few trees escape its attacks.

In the apple the roots are but rarely attacked; the foliage, however, is largely eaten by the perfect insect. On the other hand, the perfect insect rarely attacks the olive, but the larvæ often cause serious injury to the roots, especially in the case of young plants.

In the extensive olive-plantations of Dr. Campbell at One-Tree Hill, I noticed numerous young trees attacked by the grub, and on examination found the finer portions of the roots had been eaten away, and the trees injured to such an extent that growth had been arrested; the leaves were of a yellowish tint, and presented a miserable, starved appearance. In all respects they afforded a strong contrast with hundreds of trees in the same plantation, planted at the same time, and exhibiting a most luxuriant growth.

The life-history of the grass-grub has been recently made out, and may be briefly stated here. In its perfect state the insect is a small dark-brown beetle, about half an inch in length; the head is often dotted, and the wing-cases are marked by four smooth longitudinal lines, with or without a row of minute dots on each side. The legs are yellowish brown, with three large teeth in the middle joint of the foremost. It makes its first appearance in Canterbury about the commencement of November, but most likely a few days earlier in the North, and may be met with until the close of January, sometimes in countless numbers, and in this state feeds on the leaves of apple, peach, plum, mulberry, vine, and many other trees. It especially affects untrimmed furze-

hedges in the month of November, but late in the season the furze is abandoned for other plants, probably owing to the increasing firmness of the epidermis. It rarely makes its appearance until the shades of evening are fairly advanced, and is of quick but not lofty flight. During the day-time it becomes inactive, usually hiding amongst the loose soil at the base of trees or large herbs, but not restricting itself to situations of this kind. As a general rule, it commences to deposit its eggs about the third week in November, most frequently at the base of the stems of grasses or other plants, but sometimes amongst the loose soil on the surface of a sloping bank, or beneath loose litter or dry farm-yard manure, &c.

I have not observed the larval or grub state earlier than the second week in December, at which date specimens may occasionally be found less than one-eighth of an inch in length. When it has attained its full size it is from five-eighths to three-quarters of an inch in length, with a hard, yellowish-brown head, one pair of short antennæ, and three pairs of legs; its segments are thirteen in number, and partially clothed with scattered rigid hairs. In this state it is a voracious feeder, and lives on the delicate fibrils of the roots of grasses and other plants. As its voracity continues unimpaired for ten or eleven months at least, it is obvious that its ravages must be of a serious character.

The time during which the insect remains in the pupa-stage, although liable to considerable variation, is very short, often not exceeding a fortnight. Further observation, however, is required with regard to this point, as the duration of the pupa-stage is likely to be affected by the food-supply.

In many instances the insect remains in the larval condition for two years, and there is good reason to believe that it may occasionally remain three years in this state. Whenever its larval existence is thus protracted the grub is found at a greater depth than usual, and is of slightly larger dimensions.

Although the grub is never hatched before the middle of December, the effects of its ravages may be observed about the third week in January. The injured grass presents a flaccid appearance, at first confined to single roots or small patches, which increase in number and extent daily. The herbage turns black, shrivels, and dies away, so that by the close of February the once-flourishing pasture is disfigured by a series of unsightly barren patches, often connected to a greater or less extent.

Lawns suffer severely from its ravages, the grass being killed for spaces extending over many square yards, and the surface more or less broken up.

In the Te Anau District I found a compact sward of mixed Native and European grasses, the roots of which had been completely destroyed, but owing to the dense growth the culms had become so matted that large sheets were blown about by the wind, leaving the ground quite bare. The destruction was more complete than if it had been effected by rabbits.

When the roots of trees are affected by the grub the leaves turn brown or yellow, the tips of the branches droop, and ultimately fall away. Young plants die from exhaustion; older plants are better able to endure the attack, and after a longer or shorter period of prostration often recover; but the season's growth is lost, and in the case of fruit trees the crop is prevented from reaching maturity.

Cryptomeria elegans seems especially liable to attack when young; the strongest growing pines are not exempt, as *Pinus insignis, Araucaria imbricata, Cupressus Tournefoltii, C. macrocarpa;* the sycamore, oak, ash, and other deciduous trees are subject to the attacks of this voracious pest, and it is now showing an undue partiality for the roots of the strawberry.

In the larval state the insects may be destroyed by watering the ground with a solution of caustic potash, the efficiency of which would doubtless be increased by the addition of sulphur. This would perhaps be rather costly for general application to grass lands, but the cost would be trivial for the preservation of valuable fruit-trees, and would not prevent its application on the first indications of the ravages of the insect on lawns.

Nitrate of soda has been applied as a top-dressing on grass-lands, at the rate of from 1½cwt. to 2cwt. to the acre, but I do not know with what results.

The grub may be destroyed by mixing soot or sulphur with the soil, or by soaking it with soapsuds, or by pressure on the surface. Ploughing and harrowing are effectual on a large scale, as the grub is singularly impatient of any disturbance of the surface-soil.

Mr. R. C. Barstow, of Epsom, informs me that after feeding on the leaves of the castor-oil plant the beetles are seized with a peculiar stupor, and on hot days die in large numbers, but during cloudy weather they are, unfortunately, apt to recover.

In many places the beetles may be collected by the bushel, on shaking the branches of a tree, and laying a sheet underneath.

The Ringer.

At Takapuna I found two olive-trees with the leaders and upper branches either dead or dying. On examining the stems I discovered that a ring of bark, a quarter of an inch in width, had been eaten away by an insect, at the height of about five feet from the ground, and several branches rather lower on the stem had been treated in the same way; the process being practically identical with that which would be adopted by a woodman who might wish to kill a tree without falling.

The largest stem was five inches in diameter; the branches varied from three-quarters of an inch upwards; all the branches were destitute of leaves, and the bark was shrivelled and partly discoloured; the upper portions of the leaders were in the same hopeless condition, but from their larger dimensions they were able to protract the period required for their exhaustion, and still carried a few discoloured leaves on the twigs nearest the seat of injury.

A perforation on the upper side of each ring marked the entrance to the gallery, which was found to be driven transversely until it reached the pith, when it descended for about an inch. No trace of an insect was found except in one burrow, where the shell of a grub was observed, apparently hardened by some secretion of the wood, which had rendered it so extremely brittle that it fell to pieces on being touched with a knife.

I regret my inability to add to the unsatisfactory statement given above, as it is evident that the olive-grower will have to deal with a dangerous enemy, should the unknown insect become widely diffused. It appears to have been recently introduced into the colony, as its operations are so singular in their character, and at the same time so fatal in their results, that it is scarcely possible for them to have escaped notice.

In two instances the insect appears to have been unable to carry the furrow round the trunk on an even place, the termination being from three to six-eighths of an inch above the commencement, so that the groove assumed a spiral direction.

It is probable that the female insect punctures the bark and deposits a single egg in the sap-wood, after which she proceeds to "ring" the stem in the manner already described. The limited dimensions of the burrow, which in no case exceeded an inch in length, militates against the idea that the ringing is performed in order to provide a supply of dead wood for the food of the unborn larvæ, unless the grubs forsake the burrows and pass a portion of their existence on dead twigs before entering upon the pupa-stage; but there is no evidence to support this conjecture.

In all probability the insect to which I have given the name of the "ringer" will prove to be a beetle belonging to the Cerambycidæ, but its position can only be determined by examination in an advanced stage.

OLIVE-STOCKS.

Four species of olive are indigenous to New Zealand, they are commonly called maire, and afford valuable timber. One of these, *Olea apetala*, is also found on Norfolk Island, where it is known as ironwood.

The other species, *O. Cunninghamii*, *O. lanceolata*, and *O. montana*, might be profitably utilized as stocks for the cultivated kinds. It is desirable that experiments should be made in this direction.

In all probability *O. lanceolata* will prove to be the most valuable for this purpose.

PEACH.

Peach-blight.

The peach is liable to the attacks of numerous fungoid and insect-enemies capable of effecting a serious diminution in the yield, and of exhausting the energies of the tree; but the total amount of injury caused by these unwelcome parasites during a long series of years would be but trifling when compared with the wholesale destruction that has overtaken the peach throughout the colony, and to which the term "peach-blight" is generally applied. Thousands of acres of peach orchards and plantations in the North Island have been destroyed—the grand peach-groves of the Maoris in the Hokianga, Kaipara, Waikato, Napier, and Wanganui Districts are things of the past, and the peach itself, once the most common fruit in the colony, has now become the rarest. It is no exaggeration to say that, by the destruction of the peach, the value of the yearly food-supply of the colony has been diminished to the extent of several thousands of pounds.

The first symptoms of peach-blight are usually exhibited after cold winds during the flowering season and before the full development of the leaves. The ovaries swell until the young fruits attain the size of a large pea, when a sudden arrest of growth takes place and they drop from the trees, in many cases not even a solitary fruit being left. The leaves also fall away without attaining their full development. At or before this time orange-coloured dots or punctures, doubtless of a fungoid nature, are formed upon the young twigs, and in some instances become confluent, ultimately leading to the disintegration of the bark, followed by an exudation of gum at the affected parts. The buds decay and become infested with thrip or other insects to a greater or less extent, the bark becomes shrivelled, and the affected shoot dies. As a general rule, the lowest branches are affected before the upper. Sometimes the tree is killed by the first attack, but usually, on the approach of autumn, new leaves are produced towards the tips of the young shoots. Although in many cases the new leaves are attacked by a fungus, the plant seems in a fair way for recovery, but in the following spring the same sequence of incidents occurs, and sooner or later the tree dies.

All the symptoms enumerated afford evidence that the constitution of the plant has become weakened; the vital processes are not properly performed, so that the plant is not only unable to endure sudden changes of temperature, but is more liable to the attacks of fungi and insects, while it has less power to resist them.

Amongst the facts which might be adduced in support of this view the following may be selected: (1.) The simultaneous appearance of the decay in various parts of the colony, its rapid extension, and uniform results. (2.) The similarity of results exhibited in other countries where the peach has received similar treatment. (3.) Trees are destroyed at all periods of growth, from seedlings a few inches in height to trees in full bearing. (4.) No external conditions can insure safety. Trees in sheltered positions suffer in the same manner as those fully exposed, although in some instances a sheltered position appears to retard the progress of exhaustion. On the other hand, trees grown in sheltered positions are speedily exhausted when the shelter is removed. (5.) If the demand upon the vital energies of an affected tree is reduced by removing a portion of the branches,

the remaining branches usually exhibit an improved appearance, although of a temporary character. (6.) If a tree be headed down when first seen to be affected, luxuriant and apparently healthy branches are speedily given off from the stump, but this also is only temporary; the old signs of weakness are usually exhibited the following spring, if not before.

This weakening of the vital energies of the plant has been mainly effected by growing peaches on their own roots, and is to be seen in all countries where such a course has been followed. This is notably the case with the old Maori peach-groves, where one generation of trees after another has grown up from seed, and the same may be said of the cultivated trees in the orchards and gardens of the settlers. All the peach-trees in the colony have been either raised from seed or have been worked on peach-stocks.

The first step in the work of renewal will be the selection of a suitable stock, and this we find in the mussel-plum, the stock invariably adopted by English nurserymen, who have to carry on the cultivation of the peach under far more unfavourable climatic conditions than prevail with us.

It is advisable that the new stocks should be worked with buds taken from sound healthy trees. Trees of one year's growth from the buds could be purchased in England at £5 per one hundred, so that a few hundreds might easily be imported with a quantity of stocks. The dying trees might be cleared away at once, and a new start made on a satisfactory basis.

Trees worked on the mussel would be more hardy, better able to resist adverse influences, while their productive power would be increased rather than diminished. They would not be exempt from the occasional attacks of curl and other fungi, nor from the numerous insect-pests that infect the peach, and they would still be subject to sudden changes of temperature during the flowering season; but I do not hesitate to express my belief, whatever may yet be discovered with regard to the decay of the peach, that the adoption of the mussel-stock would once more allow of its profitable cultivation. Whatever new facts may be brought to light by a careful examination of the phenomena to be observed in the spring, the adoption of a new stock lies at the base of all remedial measures.

In an Auckland nursery I observed two healthy trees—the only trees absolutely healthy there; all the young stock, even the seedlings still in the seed-bed, being badly affected. The two healthy specimens were worked on mussel-stocks.

Three varieties of peach are stated by some to be "blight-proof:" the Comet, Solway, and Early Rivers. This statement, however, must be received with some qualification, as I have seen the first and second in a dying state, and feel very doubtful about the third. Had the assertion been confirmed it might have been worth while to have double-budded the mussel, using one of these varieties for the first working.

Affected trees have been headed down and succesfully worked with certain varieties of plums when the decay has not been too far advanced: time is required to prove the permanence of the scion. Should present expectations be realized we shall have one of the most striking instances of the influence of the scion upon the stock that has yet been brought forward. I am assured, however, that some varieties of plums do not succeed under such conditions.

One instance in which the process of exhaustion appeared to be retarded by remedial measures came under my notice at the Bay of Islands. Mr. Goodhue, nurseryman, of Taumarere, washes or syringes all his fruit-trees during the winter season with a mixture of lime, sulphur, and carbolic acid in the following proportions: two gallons unslaked lime, 1lb. sulphur, ¼lb. Calvert's carbolic-acid powder. Sufficient water is put upon the lime to slake it; the sulphur and carbolic powder are added and thoroughly incorporated. It can either be used dry as a fine powder to dust affected trees, or by the addition of water can be made into a wash of any required consistency. Mr. Goodhue's fruit-trees were remarkably free from insect-pests; in every case the bark was bright and clean, and the trees generally were in a vigorous state of growth. All his peaches, however, showed unmistakable evidence of gradual decay, although he informed me they had greatly improved since he commenced his treatment: the bark looked fresh and was less shrivelled than usual, but the presence of dead shoots, with occasional gummy exudation, told its own tale. Unquestionably the application of the wash had proved beneficial in destroying all insects, and thus lessening the strain upon the vital energies of the plant.

Curl or Blister *(Taphria deformans)*.

This well-known pest is a troublesome enemy to the peach-grower, and is one of the first parasites to make its appearance on trees affected by peach-blight. Although commonly considered to be caused by insects, it is in reality a fungus of very simple structure, but remarkable for its effect upon the leaves, which are curiously contorted and curled, often presenting the appearance of being covered with whitish blisters. The fungus consists of a thin layer of cells developed on the surface of the leaf and containing sporidia, which cause the leaves to look as if they were dusted with flour.

The best remedy is to dust the leaves with sulphur. Mr. Goodhue's mixture would, doubtless, prove beneficial.

Other species of fungi are found on the leaves of the peach, but at present little is known about them.

Peach-aphis *(Aphis amygdali)*.

Two or more species of aphis are found on the peach, but the form most frequently observed appears to be identical with the common peach-aphis of Europe. The aphis frequently occurs on the peach in great abundance, and accelerates the process of exhaustion caused by peach-blight, of which it is not unfrequently said to be the cause.

For treatment, see under "Orange-aphis," page 15, *ante*.

Thrip.

See under "Lemon," page 16, *ante*.

Caterpillar.

The caterpillars of several small moths feed upon the leaves of the peach, but at present sufficient information has not been obtained to allow of their identification.

For treatment, see under "Lemon," page 16, *ante*.

Scale.

The apple-scale is occasionally seen on the peach, but only in districts where it is generally distributed. In Auckland the Native sandalwood-scale is attacking the peach amongst other fruit-trees.

The castor-oil mixture, as recommended for apple-scale, will prove equally efficacious with the scale-insects found on the peach.

Borer.

The peach is occasionally attacked by a boring insect, but at present the insect itself has not been observed during any stage of its existence.

PEAR.

Slug-leech. Pear-slug. *(Selandria cerasi.)*

In its larval state this sawfly is terribly destructive to the pear, plum, cherry, and hawthorn; it may occasionally be found on the peach, apricot, and walnut, but rarely in sufficient quantity to cause much injury, although it is certainly becoming more frequent on the walnut, and occurring in larger numbers.

The slug makes its earliest appearance on the leaves soon after midsummer, but in some localities it may be as late as March; usually it occurs in vast numbers, several slugs being found on a single leaf.

The leaves are speedily devoured, and the fruit falls without ripening. In favourable seasons trees in a robust condition sometimes produce a second crop of leaves, but these never attain their full size although they remain on the tree long past the usual time. The attack is repeated in following seasons, and after presenting a miserable appearance for some time the plant dies.

The eggs of the sawfly are deposited on the upper surface of the leaf, and the slugs make their appearance in a few days, but require a month to attain their full size; they are blackish green in colour, rather more than half an inch in length, and consist of thirteen segments, the thoracic segment being the largest, and the abdominal segments gradually decreasing in size so that the larvæ present a clavate appearance. It is covered with a viscid slime, and emits a most unpleasant odour. Two rudimentary feet are carried on each of the three thoracic segments, and two sucker-feet on each of the abdominal segments except the first and the tail, so that the slug is twenty-footed. In about a month's time the slug assumes the appearance of a buff caterpillar, and soon afterwards descends to the ground, where it enters the soil and forms a small cocoon, in which it passes the dormant stage of its existence.

Two broods are produced during the summer in the northern parts of the colony, and probably in some parts of the South also.

An opinion prevails that the attacks of this insect are decreasing in severity, and that it makes its appearance later in the season than formerly. I believe a change is taking place in the date of its first appearance, but I have seen no evidence to warrant the conclusion that its numbers are diminishing.

Remedies.

It is not difficult to destroy the slug, although a little perseverance is often required to effectually clear the tree.

The most popular remedy at this time is an infusion of white hellebore, made by pouring a gallon of boiling water over one ounce of the powdered herb, and allowing it to stand until cold, when another gallon of water should be added. The infusion may be used at once. It should be applied with a syringe or garden-engine. A weak solution of caustic potash would be even more efficacious.

Dusting the trees with quick-lime, or even with common road-dust or wood-ashes, on a wet morning has been found sufficient to clear badly-infested trees. Even dry sand has been used with advantage, notwithstanding its weight. Mr. Goodhue's dry powder would be excellent.

In many cases it will be found necessary to repeat the application at intervals of ten days, in order to destroy any larvæ as fast as they are hatched.

PEAR-SCALE.

(1) Mytilaspis pomorum.
(2) Aspidiotus camelliæ.
(3) Diaspis santali.

The first of the scale-insects enumerated above is frequently found on the pear, often in great abundance; the second, although, like the first, of European origin, is only met with occasionally. The last is of native origin, and is unhappily becoming frequent on many of our fruit-trees.

I have read newspaper paragraphs stating that the oyster-scale is troublesome on pear-trees in the colony, but I have seen no specimens. In all probability the camellia-scale, which is of occasional occurrence on pear-trees, has been mistaken for it.

For treatment, see under "Apple-scale," page 7, *ante*.

FIRE-BLIGHT *(Rœstelia cancellata ?)*.

At Whangerei, the Bay of Islands, and other places, pears are attacked by what is termed "fire-blight," which destroys the tree in a longer or shorter period. Some varieties are more subject to attack than others, notably the Summer Bon-chrétien, which in the North appears to be dying out from this cause.

Unfortunately I was unable to gather much information respecting fire-blight, as my examination of affected trees did not begin until the last week in May, when the leaves had all fallen. Its first indication is said to be the appearance of black blotches on the leaves; these increase in dimensions until the greater portion of the leaf-surface is discoloured (my informants differed as to the presence or absence of blisters): at length the leaves fall, the fruit shrivels, and cankerous patches are formed upon the bark. The disease spreads with great rapidity, and is most severe when the trees are growing in a cold damp subsoil. Further observation is necessary before the pest can be identified with certainty or remedial measures suggested. But little doubt, however, can be entertained as to the injury being caused by a fungus, which will, in all probability, prove to be a well-known European species *(Rœstelia cancellata)*.

Affected trees may be headed down and grafted with some variety capable of resisting the attacks of the fungus. In two cases I was assured that this course had been followed with success, the Summer Bon-chrétien having been replaced by Williams's Bon-chrétien with the most satisfactory results.

PLUM.

SLUG-LEECH.

SEE under "Pear," page 21, *ante*.

SCALE.

As with other fruit-trees, two or three species of scale-insects are found upon the plum.

For treatment, see under "Apple-scale," page 7, *ante*.

BORER.

In the northern districts the plum is attacked by a boring insect, which often causes the decay of the upper portions of the branches. At present the insect has not been obtained in any stage.

APHIS *(Aphis pruni)*.

This species is sometimes abundant on the under-surfaces of the leaves, which are often curled, and afford copious shelter to the insect. Its ravages are often of a serious character.

For treatment, see under "Apple-aphis," page 8, *ante*.

STRAWBERRY.

GRASS-GRUB *(Odontria zealandia)*.

THIS voracious pest is yearly becoming a more serious enemy to the strawberry-grower. It feeds on the roots, and speedily impairs the vigour of the plant, so that growth is checked, the plant becomes stunted in appearance, and is unable to mature fruit.

For description and treatment, see under "Olive," page 17, *ante*.

VINE.

VINE-MILDEW *(Erysiphe*, sp.*)*.

THIS troublesome fungus is more generally known under the name of *Odium Tuckeri*, but fungologists are now agreed that it is simply an obscure state of some species of *Erysiphe*, producing secondary spores. It forms patches of delicate white mould on the leaves and stem, the mycelial threads being of exteme tenuity, and giving off erect filaments, which develope minute spores (conidiospores) by a process of transverse division.

The most approved remedy is sublimed sulphur, dusted freely over the affected parts. In all probability washing the affected leaves with a solution of permanganate of potash—say, two ounces to a gallon of water—would be found even more effective.

Vine-louse (*Phylloxera vastatrix*).

The occurrence of this much-dreaded pest in the colony was recorded by Mr. J. A. Pond in the Auckland newspapers of May last. On my arrival in that city I visited Mr. Pond's laboratory, and was courteously permitted to examine specimens of the insect mounted for the microscope, and found that it differed from the typical *Phylloxera vastatrix* in some particulars, notably in the length of the rostrum in the larval forms.

The doubts which then arose in my mind with regard to the correctness of the identification have been strengthened by a close examination of the specimens sent by Mr. Pond to the Colonial Museum. Therefore, while fully assenting to the correctness of the generic identification, I must for the present hold the identity of the Auckland insect with the vine-louse of Europe and America "not proven."

It may be worth while to state the history of the affected vines, so far as I have been able to ascertain it. About four years ago Mr. Isaacs, of Remuera, erected a vinery, and instructed his gardener, Mr. H. Allen, to prepare a border, and to order certain vines from Britain. The border was prepared by Mr. Allen, who is an intelligent gardener, and bears a high reputation as a vine-grower. The plants were supplied by a well-known firm of nurserymen in Scotland, who obtained one or two special varieties from an eminent vine-grower in England. They were planted in a Wardian case, and shipped by way of Melbourne, where they were detained for a short time, pending transhipment, but I could not learn that the case was opened until its arrival in Auckland. In the meantime Mr. Allen had left the service of Mr. Isaacs, and the vines were planted by his successor, but appear to have been sickly almost from the first, the growth being weak and miserable, and the plants, as I was informed, infested with mealy bug and other pests. This continued until May last, when specimens of the roots were submitted to Mr. Pond, who discovered Phylloxera upon them. Acting upon Mr. Pond's advice, Mr. Isaacs had the vines destroyed, the vinery washed and fumigated, and the soil in which the vines were grown burned, in order to extirpate the pest. It is, however, matter for regret that specimens of the roots and leaves of the affected parts were not preserved in spirit or glycerine for satisfactory reference.

On visiting the vinery it was evident that the work of destruction had been efficiently performed. I was unable to procure a scrap of leaf or root to ascertain the extent of the affection. The gardener in charge informed me that he did not enter the service of Mr. Isaacs until some time after the vines had been planted, and that he found them in a dirty condition, laden with insects. The remedies which he applied were uniformly without effect. On examining the roots many of the fibres were covered with small galls, and the greater portion of the roots appeared to be powdered with a fine white dust something like flour. He did not observe any galls on the leaves. In some places the roots extended beyond the border into the clay subsoil, and were perfectly clean. On the other hand, fibres given off inside the house were badly infested. Weeds or other plants growing on or about the border were not affected in any way, their roots being perfectly clean.

Perhaps the most satisfactory feature of the case is that, although the insect must have been introduced nearly four years ago, it does not appear to have spread. Although I examined the roots of numerous vines in Remuera and other places, no instance of its occurrence came under my notice, nor could I hear of any one who had seen it. Mr. Allen informed me that he had some rooted cuttings taken from the waste prunings of the affected vines last year, and invited me to examine them in his garden, which I did, but was unable to observe any trace of the insect. Some of these cuttings forwarded to Wellington, and kept in soil in a warm room, have remained perfectly clean up to this date.

Now, it is extremely difficult to imagine that typical *Phylloxera vastatrix* could have remained for between three and four years without having spread to vines in adjacent gardens and vineries. Such an occurrence could only be explained by the non-development of winged forms during that period—a phenomenon at variance with all that is known of its life-history.

Life-history of Phylloxera vastatrix.—This remarkable Aphidian insect exhibits two series of forms—one infesting the roots of vines, the other the leaves and stem. They have been distinguished by Professor Riley as Radicicola and Gallicola respectively. Both series exhibit a wide diversity of form, and the larvæ vary in appearance with each successive moult. More than twenty different forms were drawn and described by M. Lichtenstein in 1876. In Europe the subterranean form effects the greater amount of injury; in America the aerial forms are most dreaded. The winged aerial female is developed from a true egg deposited the previous autumn, and is about 0·070 of an inch in length, flask-shaped, and contains numerous pseudova; the suctorial beak is about one-fourth the length of the body. She becomes the mother of the colony, and punctures the leaf in such a way as to cause an increased flow of sap to the wounded parts, resulting in an unhealthy growth, which forms a gall completely surrounding the insect; in this gall she deposits many hundreds of egg-like bodies during the summer months. After the larvæ have developed they descend to the roots in such vast numbers as to give the fibres the appearance of having been dusted with flour. The bark of the root decays and falls away, while small knots or galls are formed on the fibres. The affected vines at this stage present an unhealthy, stunted appearance. The wingless subterranean female is only 0·026 of an inch in length, and her body contains but few eggs. She produces five or six generations, so that larvæ of various sizes and different forms are found on the same root. Shortly after midsummer many of her progeny develop wings and ascend to the surface, when they migrate to other districts, where they produce true males and females, the latter being more numerous than the former. In this condition they are about 0·120 of an inch

in length; each contains a single egg, about 0·015 of an inch long, which will give rise to the true male or female, the egg from which the last is developed being larger than that which gives rise to the male. Pseudova capable of producing true males and females may, however, be produced by wingless forms also. The true male is smaller than the female; both alike are destitute of a mouth, and exist for reproductive purposes alone. Both male and female are wingless. On the fourth day after the female is hatched she deposits a single egg in the crevice of the bark, where it remains during the winter. The winged forms are unable to cross extensive plains or seas, but the true ovum retains its vitality for a considerable period, and may readily be transported. The subterranean larval forms may easily be carried from one country to another on the roots of infested plants.

The Phylloxera found at Remuera differs from the typical *P. vastatrix* in the greater length of the suctorial beak of the larval forms, in which it is much longer than the body, and presents a singular appearance. In the great length of the rostrum it resembles a subterranean form of the well-known American blight-aphis, *Schizoneura lanigera*, but, so far as I am aware, no similar state has been recorded amongst the numerous changes of form assumed by the typical grape-louse, although it has received a greater amount of attention and given rise to a more extensive literature than any other insect.

No satisfactory remedy for the attacks of the vine-louse has yet been discovered. Flooding the affected vineyards has proved beneficial, but a remedy of this kind can only be applied in special situations. An open phial containing two ounces of carbon disulphide, placed amongst the roots of the infested vines, has produced good results, but must be handled carefully, as the vapour is poisonous.

Most of the remedies proposed, as sulpho-carbonate of potassium, arseniate of copper, &c., are dangerous to human beings, and must be used with the greatest caution.

In the case of a vinery, or a few isolated vines out of doors, being attacked by Phylloxera, the insect could be destroyed by saturating the soil with a solution of caustic potash and sulphur. The cost would be much less than the value of the fruiting vines, to say nothing of the expense attending their destruction, the formation of a new border, replanting, and total loss of the crop for two or three years. But, so long as the importation of vines is prohibited, there is but little danger of the vine-louse reaching the shores of the colony. Even should an importation take place the insect may be prevented from spreading by the prompt adoption of destructive measures. It was first observed in the British Islands in 1863, and since that year both aerial and subterranean forms have been seen in several localities in England and Scotland, but no difficulty has been found in extirpating the insect. The climate of New Zealand would doubtless prove more conducive to its rapid increase.

It is still a matter of dispute whether the typical form of the grape-louse has been observed in Australia, where it is said that the insect infesting the vines also destroys maize, peas, and other plants.

WALNUT.

Scale.

One or two species of scale-insects are found upon the walnut, but at present do not appear to have caused serious injury, although they are evidently increasing.

For treatment, see under "Apple," page 7, *ante*.

Leech-slug.

This pest is increasing on the walnut year by year, and unless checked will be found to produce serious results.

For treatment, see under "Pear," page 21, *ante*.

T. Kirk.

By Authority: George Didsbury, Government Printer, Wellington.—1885.