he may have to pay more for than he really likes.

Climatic conditions are often given little consideration in some working plans, because some people don't care to read about what kind of weather they are having in that particular locality, but only the amount of timber obtainable. When the time sheet comes round however, and the loss of time owing to wet weather is shown, the influence of the climate on the purse-strings becomes only too evident.

Having arrived at a fair inventory with sufficient details to carry one past the inquisitive contractor and a careful accountant, the second part of the forest working plan, which is also the main part of the working plan, is the description of the works and improvements which are suggested in order to maintain the area on an economic basis.

In this part of the working plan, details are again necessary, and the suggestion of an operation or an improvement without specifying the estimated time it will take with a certain amount of labour, and the cost of the various stages of the work, together with the cost of necessary equipment, will kill the proposal at once.

We all like to see an article priced when exhibited in a shop window. If the price suits us we may buy that article, if the price does not suit us we don't buy, and it is the same with the Boss. He wants to know the price, and what is more, he wants to know definitely that the cost given will not be exceeded.

This means, that the compilation of a forest working plan without actual practical experience in the various operations calls for the utmost care and the repeated verification of the cost data collected from various sources.

With experience, one will naturally acquire an amount of private cost data which will be used for the purposes mentioned and which will be a direct reflex of the ability of the collector of the facts.

The last stage of the working plan, namely the estimate or prediction of the future yield, is probably the part which is most often abused.

Statements within a certain reasonable limit as regards yields from a forest, cannot well be disputed by the average man, as he lacks the necessary data on which to carry an argument. With the compilation of an increased number of yield tables however, the prediction of yield becomes more and more liable to questioning, and no statements should be made before all the factors affecting the yield have been taken into consideration.

When on the other hand the question of yield is thoroughly understood, it becomes an easy matter for a technician to predict—after careful field investigations of similar stands—the prospective yield of the particular forest dealt with.

When using the term yield in the usual sense of the word, the yield in volume—and as a rule in cubic feet—is implied.

Quite often however an attempt is made to convert this future volume yield into an equivalent money value. Such a conversion must necessarily be based on so many assumed data, however that the value of the result is doubtful.

The main factor which makes the prediction of money yield from a forest difficult, is the steady decrease of the buying power of money, with a consequent apparent increase in the value of most commodities.

Again, the demand for the produce from the forest will influence the value in the future beyond calculations. Special local conditions may create an abnormal demand, with high prices for the produce, or the reverse may be the case owing to a glut in that particular locality.

The general deforestation carried on in most parts of the world, may enhance the value of wood beyond present day expectations, while on the other hand it is possible to imagine that some fungus or insect attacking wood may become so common and so numerous as to practically make the use of wood impossible.

It seems safe to assume however, that wood will always hold its own place in the list of necessities in the world—not perhaps in its natural state, but more and more in manufactured products such as fibre board, and the multitude of derived products, such as paper, celluloid, silk, explosives, alcohol, sugar, adhesives, lacquer, paint, non-splinter glass, aeroplane dope, etc., etc.

Keeping the depreciation of the value of money in mind, it is safe to estimate the future money yield on an increasing scale as regards the value of the forest produce—up to a certain point, when the time arrives when timber will be considered as much a crop as any other produce of the soil, and the supply and demand for wood will be balanced by the management of the world's forests according to carefully prepared forest working plans.

THE INFESTATION OF SIREX JUVENCUS IN CANTERBURY

(A. F. Clark)

Introduction

The establishment of exotic plantations in the Province of Canterbury dates back in many cases to the 'eighties or even earlier. As

soon as the early settlers found that they were unable to secure the reproduction of the native trees for timber purposes, many, with highly commendable foresight, commenced the planting of introduced species; again, the protecting of farm lands from the high parching winds was the motive that actuated many, while the aesthetic value of homestead plantations was the object in other cases. The result is that the province possesses exotic plantations to the extent of some 32,000 acres, which are being added to yearly. A forest asset is thus being built up the value of which is enormous, and which is almost irreplaceable.

It was therefore with no little consternation that the public received the news that the plantations were seriously affected by an insect infestation which threatened to encompass their destruction. Conflicting reports appearing in the daily press contributed in no small way to the general feeling of uneasiness. Most of these reports appear to have been based upon the flimsiest of evidence and are to be strongly deprecated. It was in order to arrive at the true position and to draw some conclusions therefrom that this investigation was conducted.

Systematic Description of the Pest

The insect has been variously described under the names of "The Giant Horntail," the "Steel Blue Saw Fly" and the "Wood Wasp." The first step undertaken was therefore the securing of the insect and its positive identification. The plantation at Bottle Lake was visited and here, after some searching, an infested tree was found, the tree was felled and split open and specimens of the adult of both sexes, which were about to emerge, were readily obtained therefrom.

The insect is undoubtedly **Sirex juvencus** (Linn) the common name for which is "The Horntail." It belongs to the order Hymenoptera which order is characterised by the possession of stiff membranous wings which are coupled together in flight by minute hooks; by the close union of the first abdominal segment with the thorax, and by the presence of a complete ovipositor in the female. The mouthparts are primarily adapted for biting, but also often for lapping or sucking.

The order contains two sub-orders. The sub-order Chalastrogastra has several super families, one of which, the Tenthredinoidea, contains the family Siricdae which in turn embraces the genus Sirex. The genus has the general characters of the order together with the following special characteristics:—

The coloration is striking, in the female it is blue with a high lustre but in the male the abdomen is marked with a broad yellow band. The size of the insect is variable. Some large specimens of the female will measure 1 inch to 1½ inches; usually smaller sizes are found, however; the male in most cases is smaller. The abdomen terminates in a spine which, in the male is short and triangular but which is longer and lanceolate in the female. This appendage, in the female, forms an exceedingly strong serviceable ovipositor and is the source from which the insect derives its common name. When at rest the ovipositor projects in a horizontal plane giving the appearance of a powerful sting. The wings are long and narrow with distinct venation; the mouthparts are strong and well formed for biting.

Life History of Sirex

The development of Sirex juvencus is holometabolic, that is, the insect has complete metamorphosis. The insect goes through four phases of development commencing with the egg stage, to the larval stage, to the pupal stage, and finally emerging as an adult, when it has the characters mentioned in the previous paragraph.

The eggs are whitish with a hard shell or chorion which encloses the embryo. The embryo is supplied with an amount of food material in the form of yolk or vitellus from which it obtains the nourishment necessary for its full development. On reaching maturity the small larva emerges and commences feeding. The grubs are whitish or yellowish in appearance with an upturned spine at the end of the abdomen. They are equipped with strong biting mouthparts with which they bite their way through the woody tissue of the tree. The digestive system extracts the nutriment from the wood, the fras or excreta being left behind as the grub moves forward. The larval stage is essentially the feeding and growing stage; the grub, developing in size, finds that its skin is now too tight so by the process of ecdysis or moulting the skin is cast. A series of such moults are gone through and the third or pupal stage is reached. This third stage is superficially a resting stage in that the insect has little power of movement, but in reality the most intense physiological changes are taking place. The breaking down of the larval tissues and the building up of new forms is a gigantic task, the completion of which sees the production of the imago, or perfect insect. The imago is concerned mainly with the reproduction of the species after the carrying out of which the imago dies.

An attempt was made to commence the study of an individual specimen through all these stages with a view to ascertaining exactly how long the insect takes to pass from one stage to another. As will be seen, the larval stage is the one in which damage by this insect is caused, while the length of the life cycle should be known with reasonable

accuracy if control by an insect parasite is attempted. It is therefore to be regretted that time and opportunity would not allow of much progress being made in this work, but it is hoped that this side of the investigation will be carried to a successful conclusion elsewhere. From specimens collected it is safe to say that the life cycle of the insect extends at least two years, and possibly longer. The origin of Sirex is Europe where it was first described by Linnaeus. The length of the life cycle in Europe is variously stated as from two to three years, but apparently it has not been definitely investigated, one authority stating that the larval life alone extends over two years, the whole life cycle taking three years. While it must be stressed that with different climatic conditions the life cycle of an insect and even its mode of reproduction can be radically changed. it would appear that at present Sirex is still following the same habits as it has in its country of origin.

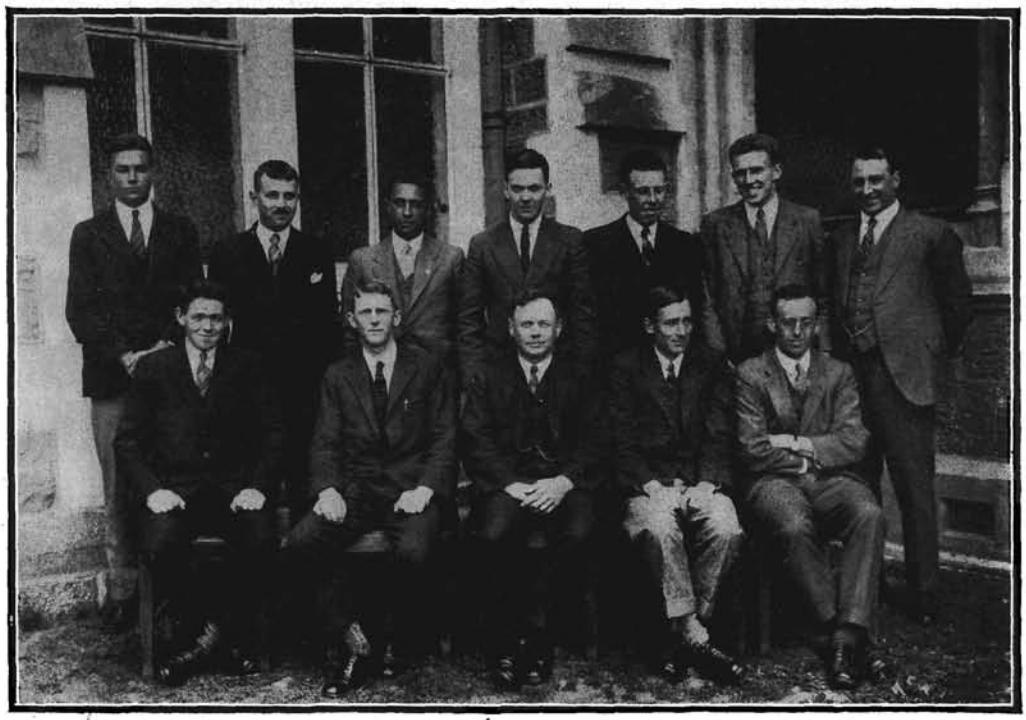
Mode of Attack by Sirex

The adult male emerges from pupation slightly before the female, but does not appear to move far from the tree from which it has emerged. The male is strong, virile and exhibits considerable ardour. Copulation takes place soon after the female emerges. The eggs are deposited by the female in the trunk or branches of the tree. After selecting a suitable spot the female pushes its body backwards by extending the legs to the fullest extent. The abdomen is then curled up and the ovipositor driven into the tree approximately at right angles so that the ovipositing insect forms, roughly, the shape of the letter "C." The stout sheath of the ovipositor is moved with a plunging motion back and forth until sufficient penetration has been obtained when the egg passes down the egg-laying-tube and is deposited in the tree just beneath the cambium layer. One egg at a time is so desposited. The object of the insect is to place the egg actually in the woody tissue of the tree and for this reason it selects the thin barked portions of the tree as a rule. The eggs hatch and produce the larvae which tunnel vigorously usually in a downward direction, working towards the pith in many cases. The tunnel is cleanly cut, and is often $\frac{1}{4}$ inch in diameter. The distance tunnelled varies considerably from 2 to 3 inches to several inches. Pupation takes place within the tunnel; the pupa is of the libera type, that is, the parts are plainly visible beneath the pupal covering. While many insects which are good borers during their larval life come close to the surface to pupate Sirex does not always do this; pupation takes place some distance inside the wood, and the adult bores its way out. It must not be inferred that the adult will commence boring again after it has emerged. The aim of the adult is to reproduce the species and to do this it must reach the surface, it therefore bores only to emerge after pupation. Adults have been found in the tree which have found the task of boring their way out too large a one and have succumbed before reaching the surface. It is seen that the larvae bore directly into the woody tissue so that when they reach the pith they are in dead non-conductive tissue and from the point of view of the well-being of the tree are in the safest place. The meristematic and conductive tissues are situated towards the periphery of the trunk or limb so that to encompass the immediate death of the tree these tissues must be destroyed. Sirex does not appear to do this. In some places a habit has been noted by which the larvae bore first inwards and then outwards again towards the cambium several times forming a number of "W" shaped tunnels. In the bends of these tunnels the excreta of the grub is desposited and by bacterial action which this deposit encourages the cambium layer is attacked and the tree ring-barked. However, as far as this investigation is concerned this habit has not yet been observed in Canterbury.

Damage Caused in Canterbury

The product of the exotic plantations finds a market in and around the City of Christchurch. About ten per cent of the timber is cut into dimensional stock and the remainder is sawn to special sizes for the manufacture of fruit cases, crates and boxes, while a third product of the mills is firewood. It is the practice of the millers to stack their sawn timber in the plantation to season. No reports have been received of attack being made upon timber so stacked or from the city timber yards in which large quantities of timber, mostly from indigenous species is being seasoned. So that Sirex does not at the moment attack sawn timber. It is the practice of the firewood dealers to buy Pinus logs which are unfit for saw-timber purposes, and cut them into 8-inch lengths; slabs and limbs are also sent in from the mills and find their way to the yards of the firewood dealers. The wood is sometimes bagged up immediately, but more often it is merely thrown into a heap. The presence of Sirex in these heaps has been recorded. Many of these trees were of small size or were defective, and no doubt the insect was present when the tree was felled. It emerges in the usual way and the adult causes considerable comment. If the female oviposits again in the firewood and it is quickly sold and burnt then little damage results.

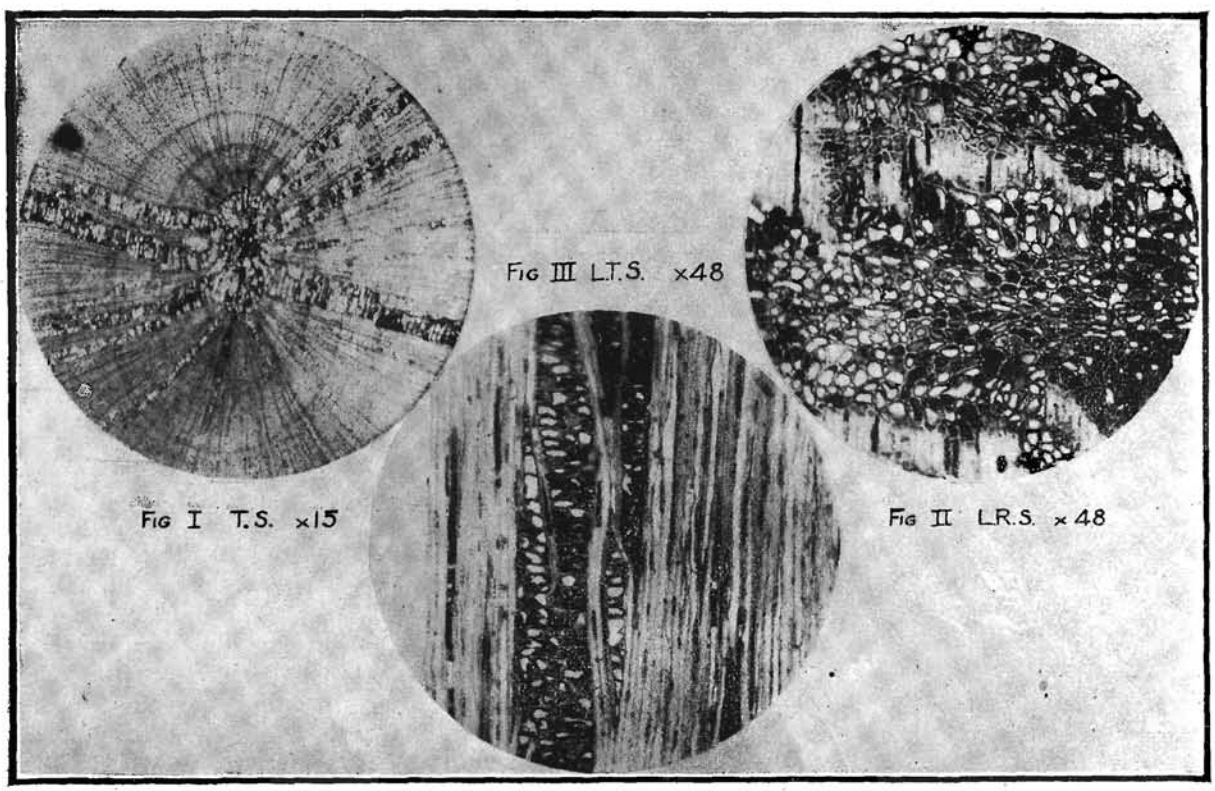
In the plantations in various parts of Canterbury, the presence of the insect has occasioned the greatest alarm. Its presence in logs and fallen trees has been noted for some time past. It is the practice of the millers, in



THE FORESTRY CLUB, 1927

Back.—G. H. Hocking, R. J. McLaren, W. Te A. Haig, D. Turnbull, W. S. Tannock
M. R. Skipworth, H. Roche

Front.—D. Kennedy, Mr. Hutchinson, Mr. Foweraker, A. F. Clark, C. S. Barker



Anomalous Tissue in Stem of Rimu

(See Text page 19)

some cases to allow considerable numbers of logs to accumulate in the plantations. If the infestation becomes acute it will necessitate a slight change in milling methods so that as soon as the tree is fallen and cross cut it is hauled directly into the mill and converted to sawn timber. In order to estimate the extent and type of damage done in the plantations the City Council's Reserve at Bottle Lake was the first visited. These plantations, which are situated on the sand dunes, are composed of Pinus radiata, Pinus ponderosa, Pinus pinaster, etc. All are closely spaced and in many cases would be considerably improved by a thinning, which would remove at least the suppressed members. However, it was only after some time and trouble that the insect was discovered in some dead Pinus radiata. No living trees were attacked. At Spye in North Canterbury, Pinus radiata forms a closely planted plantation; here numerous cases of dead and suppressed trees attacked by Sirex were found. Some of these were felled and the presence of the larvae definitely proved. Some of the trees were bearing clusters of dead needles which gave to the tree a rather unusual bronzed appearance. It appeared that the prevalent idea was that this bronzed appearance was due to the attack of Sirex so a number of these trees were felled and split but no trace of the larvae was discovered. At the time the investigation commenced in April, it is no uncommon thing to find clusters of dead needles on pines: a certain amount of leaf cast occurs every year. A further reason for the browning of the needles will be discussed later, but it is certainly incorrect to assume that the browning of the needles is wholly due to the attack of Sirex. In this plantation suppressed and dead trees were all too prevalent, and it was in these that the attack had been successful. Trees of the dominant and co-dominant classes showed no sign of attack. The soil upon which the plantation is established is a light shallow loam which overlies substrata of sandy marl.

Other North Canterbury plantations furnished evidence of attack upon P. ponderosa, P. muricata, P. radiata and other pines. Many of these plantations are also closely spaced and contain many suppressed and unhealthy members. Again it was in these members of the stand that the evidence of attack by Sirex was apparent. No case of a healthy, well-growing tree being successfully attacked was recorded. An interesting and valuable experiment is being carried out by allowing a fertilised female Sirex to ovisposit in a perfectly healthy tree; the tree will be closely observed and the result of the attack will be carefully noted. It is far too early and rather unwise to hazard the probable result, but in the meantime it has yet to be seen whether Sirex can cause fatal damage to a thrifty, well growing tree. At the time the inspection was made the presence of tufts of brown needles was frequently quoted as evidence of the presence of Sirex. As at Spye this is not wholly correct. A tree which showed these symptoms was marked and later in the year when a considerable quantity of brown needles were present .this tree was felled and examined. The tree was perfectly free from insect attack and some other cause for the wilting of the foliage must be looked for. The geologic formation is a light layer of loam over great depths of river and glacier deposited greywacke shingle.

In carrying out an inspection to ascertain the extent of an insect infestation, provided the infestation is extensive in nature the method employed is that familiar to all timber cruisers. A periphery survey of the plantation is made with chain and compass and a number of strips of one chain width, according to the percentage of the area required, are run through the plantation. On these strips the trees are examined and those showing signs of attack are noted. Thus a representative percentage of the trees are examined and serve as a reasonably accurate basis upon which to place definite figures calculated to show the seriousness or otherwise of the damage.

In the plantations inspected it was at once seen that the amount of damage caused was not large and the strip method, therefore, was not necessary. Indeed, considering the size of the plantations, especially those at Hanmer Springs, it can be said that at the moment the damage caused by Sirex is not really very great.

The areas were chosen because the geologic formation is different in each case and also because it appears that Sirex is causing damage in North and North-east Canterbury, but not in the Southern portion of Canterbury. Except for its presence in logs in the plantations which are being milled on the Plains, actual damage to standing trees in the Plains Plantations is not known so that the spread of this insect has not been great and appears to be more or less confined to that area around Christchurch, and to the North and East of the City.

Environmental and other Factors

As has been mentioned it would seem that Sirex is, at the moment, limited to some extent in its geographical distribution. It is not intended to state that Sirex does not exist in South and South-western Canterbury and maybe Otago, but at the moment the North and North-east. This is more remarkable when it is considered that the greater proportion of the exotic plantations

of the Province are situated to the south of the Waimakariri River, including those administered by the Selwyn Plantation Board, the Ashburton and Mackenzie County Councils, and many which are privately owned. It has long been recognised that climatic conditions exercise a large measure of control over the geographical distribution of insect life. Climatic conditions are effective in two ways, firstly, in what may be termed direct effects and secondly, in indirect effects. Dealing with the direct effect of climate on distribution, various and ingenious attempts have been made to fix a standard which has one single climatic factor such as, Mean daily temperature above a certain point, Total temperatures or Atmospheric moisture. It cannot be said, however, that any one single factor can be considered quite by itself, but the various factors, those of air temperature, air humidity, precipitation and air movements, should be taken together. In the same way that plants and animals are limited in distribution to some extent by the climatic conditions—insects also show the same limitations. The climatic effects are most noticeable in the distribution, rate of metabolism, life cycle and even coloration and mode of reproduction of insects. For each individual species there exist definite boundaries of humidity and temperature which limit metabolism, activity and development. There is of course a temperature below which life is impossible; similarly there is one above which life is not possible and again there is a degree of dryness which is fatal and a degree of humidity which is fatal. These factors can be correlated and humidity and temperature considered together fix limits within which the activities of an insect can move towards a maximum efficiency or decline from it, so that an optimum set of conditions can be defined under which the activities of the insect is at its highest. Outside these limits it is not possible for the insect to exist. When factors relating to climate are so important it is to be regretted that more care is not taken by all foresters to keep accurate records. Although Sirex has been known in the Province for many years its appearance in such numbers this year is probably due to optimum climatic conditions obtaining. It would also appear that these conditions existed in the North and North-east of the Province while they were not so marked in the South. It does not appear that Sirex is able to withstand a wide range of temperatures; fairly low temperatures with low relative humidity are likely to prove fatal. The second or indirect effect of climate is that of its effect upon tree growth, and together with this may be considered the soil factor. With the consideration of soil and climate the forester is inevitably brought back to the term "site quality." So far as the growth of our exotic species is concerned comparatively little data is available at the moment mainly because the stands are of no great age and in those older plantations the use of sample plots was not known until recently. It is not proposed to discuss the various methods of determining and classifying sites, but it would appear that upon areas which are of low site quality we can expect greater damage from an insect pest such as Sirex, than upon areas of good site quality. This fact is brought out into sharp relief in Canterbury mainly in connection with the pests in our Eucalypt Plantations. It was found in the plantations inspected that attack by Sirex had been successful in the cases of suppressed or partly dominated trees, or trees unhealthy for any other reason. The factors which render a plant immune or able to withstand insect attack are complicated. The presence of gums, resins, essential oils or repellent juices will help to render the plant immune and to these may be added vigour of growth, precocity and the ability to recover from set-backs. These are the factors all or some of which determine the ability of the species to resist attack by Sirex. A suppressed tree is an unhealthy tree, it is robbed of its share of light and soil moisture, its rate of growth slackens and its ability to resist attack by Sirex is definitely lowered. The condition of the root system of the tree affects to a large extent its rate of growth. Of the three plantations examined, in two cases, at Spye and at Hanmer, the trees were shallow rooted, the geologic formation rendering root penetration difficult, and in these plantations the attack was most marked. At Bottle Lake the root system developed is a deep one allowing a more regular supply of soil moisture to be obtained: attack by Sirex in these plantations is negligible. No living trees were attacked. From these few cases it is not wise to draw definite conclusions but it must be noted that root penetrations and the condition of the absorptive areas of the root system has a profound effect upon the well-being of the tree and therefore upon its ability to withstand insect attack. The ability of the tree to obtain an adequate supply of soil moisture particularly in the dry season undoubtedly raises its resistance ability.

Since anything which lowers the power of the tree to resist attack by Sirex must be considered, attention must here be drawn to the possibility of the insect attack following the successful attack of a fungus. As has been stated the browning of needles was frequently quoted as evidence of successful attack by Sirex, but this was found to be incorrect and the explanation, apart from natural leaf cast, lies possibly in the presence of the fungus Botryodiplodia pinea. A description of this fungus has been given by Dr. Curtis (Trans.

N.Z. Institute, Vol. 56 pp. 52-57), and it appears probable that this fungus is more prevalent in Pinus than is generally credited. Specimens obtained from trees showing the excessive browning of the needles showed undoubted evidence of fungoid attack, the fructifications (pyenidia) of the fungus being present upon the cones. Though time has not permitted the writer to go very deeply into this aspect it appears to be one of the very greatest importance. Dr. Curtis records the presence of Sirex larvae in P. radiata affected by Botryodiplodia and points out that the death of the tree was caused not by the larvae but by the fungus as trees killed by the fungus may show no signs of insect attack. It has been shown that Sirex will attack unhealthy or dead trees, and trees rendered unhealthy or killed by the fungus are liable to attack.

Methods of Control

It is proposed to consider two methods of control, silvicultural and biological. As regards the former method much may be accomplished by the practice of sound silviculture. In none of the plantations visited can it be said that proper silvicultural methods were being practised. It must be obvious to all engaged in plantation practice that with a close planting distance such as 8 feet by 8 feet, not all the 680 trees forming the original stocking will reach maturity. In an unmanaged state the more vigorous and thrifty members dominate, suppress and eventually kill the weaker, or again, the struggle for existence may be so evenly balanced that the whole stand becomes stagnant. It is the aim of the forester to apply his knowledge of silviculture in such a way that throughout the life of the stand a regular series of thinnings is carried out removing those trees which, through lack of form or height growth, it is unprofitable to leave.

Full use can be made of sample plot data to determine the time at which a thinning should be carried out. In the early stages of the life of a plantation little in the way of thinning is necessary . As soon as the crowns become definitely interlocked a careful thinning is indicated.

It has been seen that Sirex is attacking at the moment the unhealthy members of the stands. In a properly managed plantation these members should be reduced to a minimum or better still should be non-existent and their retention in the stand is defeating the ends of scientific management.

The second method of control is biological and supposes that since in Europe Sirex is not a great menace it is kept in check by some natural enemy. It is hoped that with the discovery of this enemy and its introduction into this country it will seek its host and exercise a like controlling influence. Parasitism among insects is of common occurrence and through its agency the balance of the insect world is largely maintained. There is no doubt that much has been accomplished by the introduction of parasites to control insect pests, but the matter is not at all easy of accomplishment. The parasite must be able to adapt itself to the climatic conditions of the country into which it is introduced; it must be more numerous than its host; that is, its life cycle must be shorter or its power of reproduction greater. Again the parasite itself should be free from parasites and it should be specific in its action. The natural enemy of the genus Sirex exists in Europe in the form of Rhyssa persuasoria. This insect belongs to the order Hymenoptera, family Ichneumonidae. The family is a large one containing many insects which are parasitic in nature upon Lepidoptera, Hymenoptera and other orders; mainly however they are parasitic upon the two orders named. The writer claims no credit for having made a new discovery as the parasitic ability of Rhyssa has been known in Europe for many years. Some confusion appears to have existed at first as to the exact manner in which Rhyssa parasitised Sirex, it being thought that the eggs were laid actually in the body of the Sirex larvae. It is now apparent that this is not so. The Rhyssa is possessed of a lengthy ovipositor with which the female penetrates the bark and wood and attempts to lay its egg in the burrow of the Sirex larva. The egg on hatching produces a legless grub which seeks the Sirex larva and attaches itself to it. It remains as an ectoparasite throughout its life and emerges later as an adult. So far as New Zealand is concerned similar species occur, the most striking being Megarhyssa fractinervis which is found in the native bush of the West Coast. The ovipositon by the Rhyssa is a lengthy process and, as in the case of the adult Sirex, withdrawal of the ovipositor is in some cases impossible and the insect dies. Whether this parasite is the factor which controls Sirex in Europe, or whether it is only one of many factors can only be discovered by studying the insect in Europe. Whether the same controlling influence would be exercised out here also remains to be seen, the acclimatisation of an introduced insect is always problematical: it may also fall an easy victim to natural enemies such as birds or an insect enemy.

Another factor in the control of insects which cannot be ignored is that of birds. Every encouragement should be given to bird life; plantation practice will not permit of the leaving of wind-throws and brush which form the natural nesting places for birds but this difficulty may be got over by planting suitable shrubs around the plantations. The study of bird life particularly of their feeding habits is well worth the attention of the forester.

Conclusion

It has been stated that the damage caused by Sirex is at the moment really quite small. This is so but given favourable conditions the insect will increase its numbers and the damage caused will be greater.

It is as well for the plantation owner to keep in view the difficulties in connection with biological control; for it is slow to establish, and requires much patient investigation. To merely say "If an infestation commences, leave it to the entomologist!" is to shuffle out of a large part of his duties and such a policy is fraught with grave danger. The prevention of a serious infestation particularly such a one as that threatened by Sirex lies in the carrying out of sound silvicultural methods and the practising of the elementary rules of forest sanitation. Many individuals and private companies have shown their long-sightedness by following the lead of the Government and planting exotics thereby increasing the national as well as their own resources. But while with the initial effort the movement has been given an excellent start, more is required. The present planting spacing of 8 feet by 8 feet is no doubt the most suitable distance, but not all will form the final crop. A series of regular thinnings throughout the life of the stand is necessary. These thinnings represent an intermediate yield and should be removed. To thin the stand and leave the thinnings lying is to defeat the main objects of the operation, those of securing an intermediate return and of keeping the stand healthy. It has been shown that Sirex will readily attack dead timber; high stumps, wind-fallen trees, and thinnings that are left to lie are favourite places for the female to oviposit. Forest sanitation demands primarily that the forest floor should be kept clear, as far as possible, of all dead and fallen matter. Trees which have become infected should be removed without delay, piled in a convenient place and burnt. The practice of removing the infected trees, sawing them for firewood and leaving them stacked for some time, possibly years, must be condemned. The larvae will live and develop just as well whether the tree is in 4 foot lengths or is entire and in due course will issue from the firewood pile as adults ready to play their part in the reproductive processes and so increase to no small extent the numerical strength of this insect pest.

With the large number of private plantations established which are in the younger stages of growth little attention in the way of thinnings will probably be necessary for some time but so soon as complete canopy is formed and definite suppression of some members takes place the commencement of a regular series of thinnings is indicated. The establishment and maintenance of the exotic plantations is one of the most striking features of present day economic development in the Dominion. These plantations in a healthy state, such as sound silvicultural methods ensure, represent an asset of enormous value; in an uncared-for state with large numbers of dead, unhealthy and suppressed trees much of this valuable asset is transformed into a definite danger. Neglected plantations of forest trees merely form in many cases breeding grounds for harmful insects. Eucalypt plantations are to be seen to-day in Canterbury which have failed through neglect or through the unsuitability of the site and these still remain a deal loss from the forester's point of view, that is financially; while more serious, they have become a mere breeding ground for our many Eucalypt pests, the control of which is becoming an increasingly complex problem. With other exotic plantations the same will apply and all those who have established or helped to establish exotic plantations should co-operate in the keeping of the stands in a healthy, properly thinned, and clean condition, thereby doing a very large share in combating the present danger and also ensuring a quicker, greater and better quality yield of forest produce from their stands at maturity.

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MEASUREMENTS IN A SAMPLE PLOT IN YOUNG RIMU

(M. R. Skipworth)

The data set out below are the result of the remeasurement in September, 1927, by the students of the School of Forestry as a field exercise in forest mensuration, of a permanent sample plot installed in January, 1921, by the State Forest Service in a stand of pole rimu near Hokitika in the tract known as Perry's Bush.