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COMMONWEALTH OF AUSTRALIA

REPORT OF SPECIAL COMMITTEE ON WHETHER QUARANTINE PRECAUTIONS BEING TAKEN AGAINST SIREX WOOD WASP SHOULD BE INTENSIFIED, MAINTAINED OR RELAXED

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CONTENTS

	Page
INTRODUCTION—	
Terms of Reference	5
Method of Inquiry	5
Witnesses	5
Evidence	5
Visits of Inspection	5
Visit to New Zealand	5
TECHNICAL DESCRIPTION OF WOOD WASPS	6
ORIGIN OF INQUIRY	7
EXTENT AND VALUE OF AUSTRALIAN FORESTS THAT MIGHT BE ATTACKED BY SIREX	7
IMPORTANCE OF AUSTRALIAN SOFTWOOD PRODUCTION IN RELATION TO TOTAL TIMBER REQUIREMENTS	8
PRESENT QUARANTINE POSITION	10
REASONS ADVANCED IN FAVOUR OF INTENSIFICATION OR MAINTENANCE OF QUARANTINE PRECAUTIONS	11
REASONS ADVANCED IN FAVOUR OF RELAXATION OF QUARANTINE PRECAUTIONS	11
EXPERIENCE OF WOOD WASPS IN OTHER COUNTRIES	12
Experience in Europe	12
Experience in North America	12
Experience in New Zealand	12
THE POTENTIALITIES OF WOOD WASPS AS PESTS OF FORESTS IN AUSTRALIA	15
FUNDAMENTAL FORESTRY RESEARCH	18
CONCLUSIONS	19
Australian Forests and Plantations represent a Valuable National Asset	19
Australian Plantations must be protected	19
Trees are killed or damaged by *Sirex*	20
Timber is damaged or degraded by *Sirex*	20
Economic Loss would be caused by the introduction of *Sirex*	20
Australian Conditions are favourable to the spread of *Sirex*	21
Quarantine Precautions should be intensified	21
Procedure recommended	22
Government Certificates from Exporting Country are desirable	23
Quarantine Fees should be waived on Timber suitably treated before shipment	23
Publicity can help	23
Strong Quarantine Action should be taken to prevent the spread of *Sirex* wherever it may become established in Australia	24
There is a need for Fundamental Forestry	24
SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS	24

APPENDICES

I. List of Witnesses who tendered Evidence at the Public Inquiry	26
II. Summary of Evidence submitted at Public Inquiry	27
General Experience	34
III. List of Persons with whom the Committee discussed its Inquiry while in New Zealand	34
IV. Instances in which *Sirex* has been found in Imported Timber, Prefabricated Houses and other goods imported into Australia	35
V. Replies given by certain European authorities to Questionnaire prepared by Mr. N. Tamblyn, of the Division of Forest Products, Commonwealth Scientific and Industrial Research Organization	35
VI. Illustrations	41

REPORT OF SPECIAL COMMITTEE ON QUARANTINE PRECAUTIONS RELATING TO THE SIREX WOOD WASP

1. INTRODUCTION

Terms of Reference

The terms of reference to the Committee were as follows:—

To examine all matters related to the importation of softwood timber infested or likely to be infested with the *Sirex* Wood Wasp and to make recommendations to the Government regarding the desirability of intensifying, maintaining or relaxing the quarantine precautions being taken to prevent this pest being established in Australia.

During the early part of the inquiry the Committee's attention was drawn to the fact that some wasps belonging to the family "Siricidae" could not be described as *Sirex* wasps because they belonged to other genera such as *Urocerus, Xeris* and *Tremex* and not to the genus *Sirex*. It was suggested that the term "Sirex Wood Wasp" in the reference should be replaced by the term "Siricid Wood Wasp." The Committee, however, considered that it was generally understood that wasps belonging to genera other than *Sirex* were covered by the inquiry and that there was no necessity to have alterations made to the terms of reference.

Method of Inquiry

The Committee, as finally constituted, held its first meeting in Sydney on 27th November, 1951, when it was decided that as far as possible inquiries should be held in public in order to give interested parties the opportunity of replying to evidence given by witnesses representing opposite interests. It was also decided that, in order to give witnesses time to prepare their evidence and because of the intervention of the holidays, the first hearing of the inquiry should be held on 21st January, 1952.

Accordingly, public inquiries were held at:—

Sydney on 21st and 22nd January, 1952.
Melbourne on 29th and 30th January, 1952, and 13th May, 1952.
Perth on 28th March, 1952.
Adelaide on 17th April, 1952.
Hobart on 21st April, 1952, and
Brisbane on 7th May, 1952.

In addition to public inquiry, the Committee, whenever the opportunity occurred, obtained technical advice on other occasions. As listed hereunder the Committee made a number of visits of inspection to State forests, to private plantations, to wharves and to the premises of private importers of timber and users of Australian grown exotic pine. During the course of such visits the Committee discussed many aspects of its inquiry. The Committee also discussed its inquiry with quarantine officers in Sydney, Melbourne, Fremantle, Adelaide, Hobart and Brisbane.

Because it was not constituted under an Act of Parliament or as a Royal Commission the Committee was unable to require evidence to be given on oath. It has no reason to believe, however, that because of this, any evidence given was in any way different from what would have been given on oath. Furthermore, full right of asking questions or giving evidence in rebuttal was given at the inquiry.

Witnesses

A list of witnesses who appeared at the inquiry is given in Appendix I.

Evidence

A copy of the official transcript of evidence taken at the inquiry is forwarded herewith. The main points in the evidence are given in Appendix II.

Visits of Inspection

During the course of its inquiry the Committee made visits of inspection as follows:—

(a) *State Forests and Plantations*
New South Wales Forests Commission plantations at Lidsdale, Jenolan and Belanglo.
South Australian Woods and Forests Department's plantations at Mt. Gambier and Nangwarry.
Western Australian plantations at Mundaring Weir, Gnangara and Grimwade.
Queensland plantations at Beerwah and Imbil.

(b) *Private Plantations*
Forestry Pulp and Paper Company of Australia Ltd., plantation, Pittwater, Tasmania.

(c) *Wharves*
At Sydney, Melbourne, Fremantle, Adelaide and Brisbane.

(d) *Importers of Timber*
Empire Timbers Pty. Ltd., Sydney.
D. Hardy & Sons Ltd., Sydney.
Smith Bros. Lighterage Company, Sydney.
Alstergren Pty: Ltd., Melbourne.
George Hudson Pty. Ltd., Sydney.

(e) *Users of Australian pine*
Hearn Bros. & Stead, Perth.

Visit to New Zealand

At the Sydney and Melbourne hearings quite a number of witnesses, both those in favour of the intensification of quarantine precautions and those in favour of their relaxation, quoted the experience of New Zealand in support of their respective views. The *Sirex* wasp has been present in New Zealand forests for many years and for a long period was apparently not regarded as a serious pest. However, in recent years it has become a much more serious menace to the forests and active steps are being taken to combat it. The Committee considered that a visit should be made to New Zealand in order to study *Sirex,* to see its effect on pine forests and to obtain first-hand knowledge of methods used to overcome it.

Information gained by the Committee during its visit to New Zealand is discusssed later in this report under appropriate headings. In this section it is desired merely to make reference to the Committee's activities during its visit. The Committee wishes to acknowledge the assistance given to it during its visit to New Zealand by the New Zealand Forest Service. The Director of Forestry (Mr. A. R. Entrican) and his officers did everything they could to make the Committee's visit successful and gave it all available information on *Sirex*.

Formal evidence was taken at Kinleith from the New Zealand Timber Exporters' Council, the members of which are vitally concerned in the export of timber to Australia. Evidence was also taken at Wellington from the Assistant Director of the New Zealand Forest Service.

The Committee visited State forests at Riverhead, Woodhill, Kaingaroa, Whakarewarewa, Tourewa and Golden Downs. Private forests were inspected at Kinleith, Matahina, Pukahunui, Mapua and Notueka. The Com-

mittee visited the Forest Research Institute of the New Zealand Forest Service at Whakarewarewa. It discussed its inquiry with Dr. D. Miller, Assistant Director, and other officers of the Cawthron Institute, Nelson. It also inspected private sawmills at Penrose, Kinleith and Nelson and the Government sawmill at Waipa.

On most of its visits in New Zealand the Committee was accompanied by a number of New Zealand Forest Service officials including the Officer in Charge of the Forest Research Institute (Mr. H. V. Hinds) and the New Zealand Forest Pathologist and Entomologist (Mr. G. B. Rawlings). On some visits it was accompanied by private millers and exporters. A list of the persons with whom the Committee discussed its inquiry while in New Zealand is given in Appendix III.

II. TECHNICAL DESCRIPTION OF WOOD WASPS

Wood wasps belong to the family Siricidae. The Siricidae together with several related families comprise the sub-order Symphyta of the order Hymenoptera. Like the sawflies and other representatives of the Symphyta the wood wasps have the abdomen joining broadly to the thorax without the constricted propodeum which is characteristic of the more familiar representatives of the Hymenoptera, namely the bees, ants and wasps. The wood wasp is, however, quite different from the sawfly in the general shape of the body which is relatively long and slender, and in the structure of the ovipositor which is adapted for piercing and boring whereas that of the sawfly is adapted for sawing and slitting. The general appearance of an adult wood wasp may be seen in Figure 1. Close examination will reveal the presence of four wings. In flight the two on each side are coupled together to function as one. The shape and length of the antennae, the relative length of ovipositor and wings and the colour pattern, particularly of the head and legs, are the chief characters used in the classification of the Siricidae. Size is not a reliable character for it may vary enormously within the one species. For example the length of *Urocerus gigas* may vary from 12 mm. to 50 mm., of *Sirex noctilio* from 11 mm. to 40 mm., and of *Sirex cyaneus* from 10 mm. to 24 mm. The wingspread of a large specimen of *S. noctilio* is about 55 mm. and of a small one about 20 mm.

The family Siricidae is classified into two sub-families comprising some eight genera of which *Urocerus, Sirex, Xeris* of the Siricinae and *Tremex* of the Tremecinae are well known examples. Each genus is further subdivided into species. Benson[1] lists 44 species from various countries. These differ from each other not only in appearance but also in other biological details such as duration of life-cycle, preferred host trees and climatic requirements. It is necessary to mention the systematic classification of the wood wasp family because it is important to recognise certain species. Moreover certain generalisations of value for the purpose of this report may be based upon it. For example it is known that species belonging to the sub-family Siricinae are virtually restricted to coniferous trees as hosts whereas those of the sub-family Tremecinae live only in broad-leaved trees such as oak, maple and beech.

The sub-families of the Siricidae may be distinguished on the following characters. In the Siricinae the antennae are long and filiform and would reach beyond the stigma if stretched along the forewing from the tegula; the antennae are usually set close together; the eyes are usually no more than 1½ times as broad as long and the labial palps are usually three-segmented. In the Tremecinae the antennae are short and slightly swollen in the middle, and they would not reach as far as the base of the stigma; the antennae are set widely apart; the eyes are at least twice as broad as long; and the labial palps are two-segmented.

The species most likely to be found in timber and crates imported into Australia belong to the genera *Urocerus, Xeris* and *Sirex*. The following simple key will serve to discriminate between females of these three genera.

Head without any pale colour above and behind the eyes; cornus of the female not restricted towards the base; forewing with first transmedian vein present; hind tibia with two apical spurs; eyes about 1½ times as broad as long - - - - - - - - - *Sirex*

Head from above entirely pale or at least with a pale spot behind each eye; cornus of the female restricted towards the base; forewing with the first transmedian vein represented by at most a stump:

(a) Head without a lateral carina behind the eyes; hindwing usually with a closed anal cell; ovipositor at most scarcely longer than the forewing; eyes about 1½ times broader than long; the pale spot on the genae behind the eyes shining with sparse punctures and pubescence - - - - - - - - - *Urocerus*

(b) Head with a lateral carina behind the eyes; hindwing without a closed anal cell; ovipositor about 1½ times as long as the forewing; eyes almost round; hind tibia with only one apical spur - - - - - - - - *Xeris*

The two species of the genus *Sirex* which are most likely to be found in timber being imported into Australia are *S. juvencus* and *S. noctilio*. These are superficially alike being about the same size and much the same colour. The females are a deep steely blue and the males are the same colour as the females except for the posterior third or half of the abdomen which is a bright reddish-orange. The following table serves to distinguish between these two species.

S. noctilio

Females: All legs with apical tarsal segment black; sawsheath shorter than the oblong plate; mesopleura so densely punctured that in the middle there are no interspaces larger than the punctures; ratio of ovipositor to forewing about 1.47.

Males: Hind femora reddish-yellow; apical tergites reddish.

S. juvencus

Females: All legs with tarsus entirely reddish-yellow; sawsheath as long as the oblong plate; mesopleura in the middle with shining interspaces larger than the punctures; ratio of ovipositor to forewing about 1.34.

Males: Hind femora black; apical tergites black.

The immature stages of the wood wasp live inside the tree and are difficult to discover. Once they have been found, however, they may be easily distinguished from other wood-boring insects. The egg is situated in or near the cambium, and it may be recognized because it is situated at the base of the characteristic hole which the female drills through the bark with her ovipositor, and because it is usually surrounded by a small patch of discoloured wood. The larva is typical of the primitive Hymenoptera and is quite different from the larval forms of the Lepidoptera and Coleoptera which comprise most of the wood-boring species. It is a soft white grub with a well-developed head and heavily sclerotised mouth parts. Thoracic legs are present but greatly reduced; pseudopodia are absent. There is a powerful spine or horn protruding from the tip of the abdomen. This is said to be used for packing frass into the tunnel, but it may also be used by the larva to support itself in the tunnel.

The tunnel made by the wood wasp larva is also quite characteristic. It commences as a very narrow tunnel at about the level of the cambium; it turns inwards a little and then either upwards or downwards, but remains at first in the sapwood. Later the tunnel becomes larger (as the larva grows) and curves in to the heartwood; eventually (as the larva approaches maturity) the tunnel approaches the surface again; the pupal chamber is formed about half an

[1] R. B. Benson, Bull. Ent. Res. Vol. 34, p. 27.

inch inside the bark. The tunnel behind the larva is at all times tightly packed with frass, and at intervals the old cast skins of the larva may be found packed into the frass. The tunnel is usually about one or two feet long. It is characteristic of the adult wood wasp that in cutting its way out of the pupal chamber it nearly always makes a tunnel that is perpendicular to the surface from which it is emerging so that, whether the insects have emerged from a round log or a piece of sawn timber, the emergence hole is nearly always circular. However, when a larval tunnel is exposed by a saw cut the saw may cut through the tunnel obliquely so that the hole which is found at the surface of a piece of sawn timber may not be circular but elliptical.

A list of the occasions on which quarantine authorities have found timber infested with wood wasps is given in Appendix IV. In many instances it is not known what species was concerned. It is necessary to have adults to determine the species; mostly the wood wasps are in the larval stage when they are found, and it is, of course, customary to destroy them as promptly as possible. When adults have been found their identity has been recorded. The two species which have been found most frequently in timber and crates from Europe are *Urocerus gigas* and *Sirex juvencus*; while *Sirex noctilio* has been found at least twice in timber from New Zealand. Although *Sirex noctilio* is known to occur both in Europe and North America, there has not so far been any record of this species in timber from either of these continents.

The Siricidae are indigenous to the temperate regions of the Northern Hemisphere, and various species have been recorded from Europe, North America and Asia. In addition one species, *Sirex noctilio*, has been introduced into and has become established in New Zealand and Tasmania. It follows therefore that wood wasps of one species or another are present in all the countries from which Australia normally imports timber, and which supply the timber for most of the crates and boxes entering Australia through the import trade.

III. ORIGIN OF INQUIRY

Under quarantine proclamation 5P wood wasps (Siricidae) have been declared as pests affecting plants, and their introduction into Australia is prohibited. The importation of any timber or other goods infested with wood wasps is prohibited except under conditions prescribed by the quarantine authorities.

The list of pests declared under the Quarantine Act was originally drawn up in 1907-1908, and wood wasps were included in that list. However, it was not until 1925 that importations of timber were regularly inspected to see that they were free of wood wasps and other declared pests. In the same year live *Sirex* was found in a shipment of timber imported from Danzig, but quarantine officers consider that before that date there had been practically no importations of *Sirex*-infested timber into Australia. They also maintain that since the original list of pests was drawn up *Sirex* has been regarded as an important pest, and that it has been looked for in all timber examined by quarantine officers.

Appendix IV, which is a list of the cases in which *Sirex* has been found in imported timber, has been prepared from evidence submitted by quarantine officers and other witnesses who appeared at the inquiry. It will be noted that there were some interceptions before 1951. The treatment of these shipments apparently created no serious difficulties, and it was not until early in 1951, when heavily-infested cargoes arrived in Australia, that quarantine precautions against *Sirex* aroused much attention.

In February, 1951, live *Sirex* was found in Sydney in the holds of the S.S. *Marilen* which was carrying 2,700,000 super. feet of Roumanian white wood. Shortly afterwards shipments of timber from Czechoslovakia, Austria and Yugoslavia were also found to be heavily infested. On 30th March, 1951, live *Sirex* was found in the S.S. *Marilen* whilst she was unloading in Melbourne, and shortly afterwards the wasp was found in shipments of timber from Austria, Scandinavia, Yugoslavia and France.

When the wasp was discovered in February and March, 1951, quarantine officers ordered the cessation of discharge of timber from vessels in which the wasp had been detected. However, after some delay, discharge was allowed to proceed subject to certain conditions laid down by the authorities.

The timber importers maintained that the delay occasioned by quarantine resulted in the shipping companies making a very substantial increase in shipping freights to Australia. Shipping was scarce, and importers claimed that, if quarantine were to result in further delays in Australian ports, shipping companies would not send their ships to Australia. They also maintained that because timber was in short supply all over the world, overseas suppliers would not in future make supplies available to Australia. They claimed that the Quarantine Regulations were involving them in delays and extra expense in many other ways, and that the cost of imported timber was being increased considerably. They suggested that *Sirex* was not a serious pest, and that in any event the cost of keeping it out of the country was much greater than any harm it might do if it became established in Australia.

On the other hand forest authorities, as well as private forest owners, maintained that no pest should be allowed into Australia if it is at all possible to keep it out. They maintained that *Sirex* had been proved to be a serious pest.

In view of these conflicting opinions the Prime Minister appointed the present committee to advise the Government regarding the question of quarantine precautions against *Sirex*.

IV. EXTENT AND VALUE OF AUSTRALIAN FORESTS THAT MIGHT BE ATTACKED BY *SIREX*

For reasons given later in this report the Committee considers that it may be assumed that *Sirex* will not successfully attack Australian hardwood. Accordingly in attempting to assess what damage *Sirex* might do if it became firmly established in Australia, consideration has been given to softwood plantations and forests only.

The following table, which has been prepared from statements submitted at the inquiry, shows the acreage of exotic softwood plantations controlled by the various Government forestry authorities in Australia.

Exotic Softwood Plantations controlled by Government Forestry Authorities in Australia

Authority	*Pinus radiata*	*Pinus caribaea*	*Pinus taeda*	*Pinus ponderosa*	*Pinus laricio*	*Pinus pinaster*	*Other*	*Total*
New South Wales	29,171	1,959	1,960	1,545	1,410	1,210	1,468	38,723
Victoria	32,479	(a)	(a)	5,309	3,611	1,630	3,382	46,411
Queensland	398	8,932	3,193	(a)	(a)	(a)	2,840	15,363
South Australia	84,199	324	432	287	80	4,504	1,491	91,317
Western Australia ..	3,270	(a)	(a)	(a)	(a)	11,658	350	15,278
Tasmania	6,264	(a)	(a)	84	44	29	131	6,552
Australian Capital Territory	12,857	(a)	(a)	1,894	146	(a)	37	14,934
Totals:	168,638	11,215 (b)	5,585 (b)	9,119 (b)	5,291 (b)	19,031 (b)	9,699	228,578

(a) Information not supplied.

(b) Not including some acres possibly included under "Other".

It is of interest to note that *Pinus radiata* represents over 73 per cent. of the total exotic plantations controlled by Government authorities.

These figures relate only to plantations controlled by the Government forest authorities. There are, in addition, large areas controlled by private individuals and companies and by semi-Government bodies such as Water Commissions.

The Commonwealth Forestry and Timber Bureau supplied the following figures relating to private plantations in Australia. The acreages of various species are not shown separately, but it is assumed that private plantations would generally be of the same species as the Government plantations.

Australian Coniferous Plantations—Private Plantations—as at 30th June, 1950

Locality.	Acres.
New South Wales	7,500
Victoria	13,000
South Australia	17,920
Tasmania	2,690
Total	41,110

In supplying these figures the Bureau drew attention to the fact that because of incomplete knowledge of private plantations these figures might not be strictly accurate. It was also stated that there are practically no private or semi-Government plantations in Queensland, Western Australia and Australian Capital Territory.

In view of the fact that in New Zealand it has been shown that *Sirex* attacks have been heaviest in the twenty to twenty-five-year-old plantations, the following table relating to the age groups of Australian exotic softwood plantations and forests is of particular interest.

Australian Exotic Softwood Plantations—Government Plantations and Forests—in Age Groups

Authority	Under 10 years (acres)	10-14 years (acres)	15-19 years (acres)	20-25 years (acres)	26 years and over (acres)	Total (acres)
New South Wales	11,226	903	10,487	11,700	4,047	38,723
Victoria	10,853	5,906	14,026	12,242	3,384	46,411
Queensland	8,877	2,641	2,826	509	510	15,363
South Australia	20,521	11,720	25,397	26,199	7,480	91,317
Western Australia	3,808	2,681	4,952	3,017	820	15,278
Tasmania	5,287	1,005	142	50	68	6,552
Australian Capital Territory	3,210	5,150	5,025	1,463	86	14,934
Total:	63,782	30,006	63,215	55,180	16,395	228,578

It will be seen that trees in the twenty to twenty-five years of age group represent over 23 per cent. of exotic softwood plantations. The table is also of interest in so far as it shows what a large part of Australian forests is in the very young age group.

The capital value of softwood plantations in Australia is difficult to assess. The New South Wales Forests Commission estimated that the total expenditure on establishment, maintenance, protection, thinning, etc., of the Commission's *Pinus* plantations was more than £1,000,000. The Victorian Forests Commission stated that on the basis of current planting costs the initial establishment of an area equivalent to the Commission's present holding would have been about £2,250,000.

The following evidence by the South Australian Conservator of Forests (Mr. B. H. Bednall) is of particular interest:

"The standing (or royalty) value of the merchantable timber in the State's softwood plantations is at present not less than £10 million, and the standing value of the annual cut is more than a quarter of a million pounds, which should increase at least threefold within the next fifteen years.

"The value of the converted products of this raw material, in paper, pulp, cases, timber, veneer, plywood, etc., is obviously many—perhaps twelve—times these figures, and of considerable economic importance to the State, particularly in regard to the establishment of secondary industry.

"Apart from this aspect, the direct employment associated with the above-mentioned wood-working industries has been reliably estimated to be of the order of one person for every 25 acres of forest, which is a high ratio, particularly as it does not allow for employment in railways, shipping, secondary wood-using factories, etc.

"Any reference to the value of these forests can certainly not omit mention of a major item of importance, not only to the State, but to the whole Commonwealth. That is the knowledge that South Australia's rapidly expanding timber asset can be immediately made available for defence purposes, should circumstances warrant it. Experience gained, particularly in the last war, makes it unnecessary to stress the significance of this fact any further."

In every State the average age of pine plantations is comparatively low, so that the capital value will be increasing considerably each year. In addition each State has plans for extensive additional plantings, as under:

New South Wales. Establishment is proceeding at the rate of 3,000 acres per annum.

Victoria. The Commission envisages increasing its present holding of 46,500 acres to a permanent reserve of at least 200,000 acres, stepping up annual planting to 10,000 acres in order to achieve this objective.

Queensland. Further plantings are projected at a rate approximating 3,500 acres per annum.

South Australia. Future expansion of the present plantations of 110,000 acres is provided for to the extent of approximately 30,000 acres, and the target of the Conservator of Forests is a minimum of 200,000 acres.

Western Australia. Compared with present plantations of 15,320 acres, two projects with a combined final area of from 200,000 to 240,000 acres are envisaged.

Tasmania. A target of 25,000 acres has been mentioned as the minimum requirement of the State in softwoods in future years.

V. IMPORTANCE OF AUSTRALIAN SOFTWOOD PRODUCTION IN RELATION TO TOTAL TIMBER REQUIREMENTS

Australia's total consumption of sawn timber in recent years, and the importance of local softwood production in relation thereto, are shown in the following table:

Apparent Consumption of Timber in Australia—'000 Super. Feet Sawn Measure (excluding Sleepers)

	1949-50		1950-51	
Hardwoods—				
Australian Production	990,824		1,009,845*	
Less Exports	28,651		18,224	
		962,173		991,621
Imports		27,120		27,839
Total Apparent Consumption of Hardwoods		989,293		1,019,460
Softwoods—				
Australian Production		208,833		198,688*
Imports		221,448		352,140
Total Apparent Consumption of Softwoods		430,281		550,828
Total Apparent Consumption of All Timber		1,419,574		1,570,288

*Subject to amendment.

The States of origin and the species of softwoods produced in Australia were as under:

Australian Softwood Production—'000 Super. Feet

	1949-50		1950-51	
New South Wales—				
Exotic	11,491		11,903	
Hoop	1,966		1,487	
Cypress	40,797		33,876	
		54,254		47,266
Victoria—				
Exotic		21,293		19,265
Queensland—				
Exotic	4,809		6,832	
Hoop	39,989		34,058	
Cypress	23,088		21,382	
Kauri	3,750		4,246	
		71,636		66,518
South Australia—				
Exotic		51,766		55,709
Western Australia—				
Exotic		1,674		2,154
Tasmania—				
Exotic		3,603		3,912
Australian Capital Territory—				
Exotic		4,607		3,864
Total:		208,833		198,688

(1950-51 figures subject to amendment.)

The following table shows Australian imports of softwoods classified according to zone of origin and States of importation.

Australian Imports of Softwoods during the Year 1950-51, showing Zonal Origin—Super. Feet

Origin	New South Wales	Victoria	Queensland	South Australia	Western Australia	Tasmania	Commonwealth
Baltic	46,998,134	70,182,777	4,662,336	17,086,932	2,873,814	1,270,844	143,074,837
Other European	16,421,258	8,894,929	7,070	246,480	—	1,254	25,570,991
Asian	21,960	1,305	—	—	—	—	23,265
North American	76,274,755	26,190,246	2,673,435	31,770,507	—	201,203	137,110,146
New Zealand	8,024,042	1,587,368	515,254	892,145	—	—	11,018,809
Other Southern Hemisphere	22,321,762	9,474,229	1,390,021	824,602	1,331,547	—	35,342,161
Total:	170,061,911	116,330,854	9,248,116	50,820,666	4,205,361	1,473,301	352,140,209

The f.o.b. value in Australian currency of softwoods imported during the year 1950-51 amounted to £17,532,584. It will be obvious that increased production of Australian pine, which is equally as suitable as imported timber for most purposes, can contribute substantially to an improvement in the balance of overseas trade.

The following table shows importations of softwood timber into Australia during the four years ended 30th June, 1951. It will be noted that in 1950-51 importations from Europe were exceptionally high. This is a significant fact from which important conclusions are drawn later in this report.

Australian Imports of Softwoods—showing Zonal Origin—Super. Feet

Origin	1948-49	1949-50	1950-51	July-Dec. 1951
Baltic	64,881,324	68,863,127	143,074,837	56,918,880
Other European	125,927	581,740	25,570,991	13,923,720
Asian	11,568	1,879	23,265	1,399,470
North American	117,018,433	126,519,659	137,110,146	90,951,339
New Zealand	25,800,544	14,631,973	11,018,809	17,979,996
Other Southern Hemisphere	9,778,242	10,838,214	35,342,161	11,254,424
Total:	217,616,038	221,436,592	352,140,209	192,427,829

(All figures in the four preceding tables were supplied by the Commonwealth Forestry and Timber Bureau.)

VI. PRESENT QUARANTINE POSITION

Action to prevent the importation into Australia of goods infected with or likely to be infected with diseases affecting plants is taken under Part V, "Quarantine of Animals and Plants" of the Commonwealth Quarantine Act 1908-1950, and under the various regulations, proclamations, instructions and interpretations which have from time to time been issued under that Act. The administration of the Act generally is carried out by the Director-General of Health. In so far as it relates to plants, however, quarantine is the particular responsibility of the Director of Plant Quarantine.

When the Commonwealth assumed responsibility for plant quarantine it was arranged that the State Departments of Agriculture should, in their respective States, act for the Commonwealth in implementing the Commonwealth Regulations. When the Department of Health was established it was decided that no attempt should be made to duplicate the inspectorial service provided by the State Departments, and the arrangement with the States continued in force.

Under that arrangement the State makes some of its officers available for plant quarantine inspection work, and there is appointed in each State a Chief Quarantine Officer (Plants). With the exception of Tasmania this officer in each State is the Chief Horticultural Officer of the Department of Agriculture. In Tasmania the Chief Quarantine Officer (Plants) is the Chief Agronomist of the Department of Agriculture.

These officers and their staffs of inspectors, although State officers, are appointed under the Commonwealth Quarantine Act as quarantine officers, and are, therefore, ultimately responsible to the Commonwealth Government in respect of the duties they perform for plant quarantine.

Although Siricid wood wasps were included in the original list of pests drawn up in 1907-1908, timber was not inspected until 1925. In September, 1925, quarantine inspection fees were introduced to cover all types of timber. However, timber importers complained that such fees should not apply to certain types of timber, including Baltic, which they maintained had been imported for many years and had never been found to contain borer or other pests. The regulations were accordingly altered to make Baltic and certain other types of timber free from inspection fees. At the inquiry, however, quarantine officers maintained that although inspection fees were not charged on certain classes of timber, a careful watch was kept on all timber to ensure that no *Sirex*-infested timber was imported. Inspection fees are now payable on all imported timber.

In 1927 a Division of Plant Quarantine was established within the Commonwealth Department of Health. It is the responsibility of the head of this division, the Director of Plant Quarantine, to co-ordinate the activities of the Chief Quarantine Officers (Plants) throughout Australia.

Regarding the financial arrangements between the Commonwealth and the States, Dr. T. H. Harrison, the Director of Plant Quarantine, stated:

"The States are reimbursed for the cost of those services. The amounts have varied from State to State, and have varied over the years. Latterly they, like all other expenses, have been increasing, and the gentlemen's agreement between the Commonwealth and the State is that the States shall be reimbursed for the cost of services.

"The attitude of my Department is that quarantine must be done to a standard, which must not be determined by the amount of money made available. The service has to be rendered, and the States know that they are obligated to render that service. If it costs more than is being made available to them in any one year, they have the opportunity of claiming on the Commonwealth for reimbursement."

One complaint by timber importers at the public inquiry was that quarantine administration in the different States was not consistent. It was claimed that in Melbourne the Regulations were enforced much more severely than in other ports.

The Committee was informed by the Director of Plant Quarantine that, when heavily infested shipments of timber began to arrive in Australia early in 1951, the following instructions were issued to the Chief Quarantine Officers in all States:

(1) The holds are to be treated with an approved insecticidal mist or an approved insecticidal smoke generator, to the satisfaction of a Quarantine Officer, each morning within the period of thirty minutes preceding the lifting of the hatch for unloading.

(2) All deck cargo and all cargo already discharged shall be thoroughly sprayed immediately with 0.25 per cent. D.D.T. and 0.5 per cent. B.H.C. (Gamma Isomer) and thereafter at least once a week until heat-treated.

(3) All cargo to be thoroughly sprayed with the D.D.T., B.H.C. preparation already described, immediately on discharge, and then immediately heat-treated in a kiln previously approved by a quarantine officer. Stacks of one-inch timber shall be heat-treated for a period in the kiln of not less than seven hours, and stacks of two-inch timber for a period of not less than fourteen hours.

Where it is proposed to strip the stacks before heat treatment, shorter periods may be approved on application through a quarantine officer.

(4) The rate of unloading shall not exceed the rate at which the timber cargo can be heat-treated.

Instruction (4) resulted in some delay being caused to shipping, and after a short time it was withdrawn and quarantine officers were instructed that ships must be allowed to discharge as fast as port facilities would permit.

Following discussions and telephone conversations between Chief Quarantine Officers (Plants) and the Director of Plant Quarantine, the other instructions were amended from time to time in order to meet different requirements in different ports.

The present position is that the following broad principles have been laid down, and Chief Quarantine Officers are allowed to exercise their discretion in regard to each importation and the manner in which the principles are to be observed:

1. Before discharge of the cargo the holds of the ship are to be treated with a suitable insecticide. In some ports this treatment is done each night after unloading has ceased for the day; in others the holds are treated each day immediately before unloading commences.
2. Infested cargo is to be heat-treated or fumigated as soon as practicable after discharge.
3. While awaiting treatment the infested cargo must be sprayed at frequent intervals with a suitable insecticide. The insecticides used for this purpose differ in different ports.

Owing to the elasticity of instructions the same procedure is not being followed by quarantine officers in all ports. In some ports there are greater problems than in others. In Sydney the quarantine inspection and procedure differs from that in other capital ports by reason of the fact that, in Sydney, timber is taken from the ship by lighters which then discharge at yards or mills on the waterfront. In some cases the timber may be held in the lighters. It is in New South Wales and Victoria that the great volume of timber handled creates problems in securing a sufficiently quick passage of the timber to avoid congestion.

Mr. F. P. O'Connell, on behalf of the Timber Merchants' Association of Melbourne and Suburbs, supplied the following figures relating to the cost of treating timber for quarantine purposes:

Fumigating and spraying - -	2/3 per 100 super. feet
Heat treatment - - -	5/– „ „ „ „
Cartage, wharf to yard - -	9d. „ „ „ „
Stacking by fork lifts - -	3d. „ „ „ „
Quarantine Officers' overtime -	3d. „ „ „ „
	8/6

Mr. F. M. Hewitt, on behalf of the Sydney and Suburban Timber Merchants' Association Ltd., stated that the actual cost of heat-treatment including cartage and handling varied from 10/- to 15/- per 100 super. feet. In addition the consignee could be involved in demurrage or extra wharfage expenses because of his inability to move the timber. Mr. O'Connell agreed that the cost of treating timber in New South Wales would be considerably higher than in Victoria, and attributed the increased cost to the different method of handling timber in New South Wales.

In addition to the direct cost of treating timber, importers have been involved in other costs as a result of quarantine requirements. Mr. O'Connell quoted one case in which the extra charges on a shipment of timber amounted to £4,945. This figure included demurrage of £2,663 paid to the shipping company and £250 paid to counsel for advice on legal matters involved. In another shipment extra charges amounted to £9,281, but this included a considerable amount which could not be attributed by the importers to quarantine.

If these costs are to be used to assess the cost of keeping *Sirex* out of the country, it is important to remember that only a relatively small proportion of importations require to be treated. Further reference to this subject is made later in this report.

Apart from the cost of treatment, importers were concerned with the delay involved in treating shipments of timber. The heat treatment of timber had to be done in reconditioning chambers, and the number of chambers available was limited. Attempts made to adapt kiln drying chambers for heat-treating purposes had resulted in damage being done to them. The importers claimed that not only was the number of kilns limited, but they were installed for a purpose other than heat-treating, and while they were being used for quarantine purposes they could not be used for the purpose for which they had been constructed.

VII. REASONS ADVANCED IN FAVOUR OF INTENSIFICATION OR MAINTENANCE OF QUARANTINE PRECAUTIONS

The main reasons advanced in favour of intensification or maintenance of quarantine precautions against Siricid wood wasps were as follows:

1. There are many instances of relatively unimportant forest insects causing serious damage in a new environment.
2. The Australian climate and the conditions in Australian forests and plantations would favour the establishment and spread of *Sirex* in this country.
3. Once established in Australia *Sirex* would be capable of inflicting serious losses. Damage to pine plantations by pest or disease is more serious than damage by fire.
4. In Australia there is a shortage of softwood timber, and practically all timber obtained from the forests and plantations can be sold. Losses of timber through *Sirex* would be much more serious than they apparently were in New Zealand.
5. The value of Australian forests and plantations is such that they should not be subjected to any further risks by the introduction of forest pests from overseas.
6. Quarantine precautions are not costly, and do not result in excessive delays.
7. Timber, paper pulp, and other forest products obtained from *Sirex*-infested trees are much inferior to similar products obtained from clean trees.
8. *Sirex*-killed trees left standing in the plantations would increase the already serious fire risk.

VIII. REASONS ADVANCED IN FAVOUR OF RELAXATION OF QUARANTINE PRECAUTIONS

The main reasons advanced in favour of relaxation of quarantine precautions were as follows:

1. Timber, of the type in which *Sirex* has recently been found, has been imported for very many years. During that time *Sirex* must also have been imported into Australia and
   (a) failed to survive; or
   (b) is present in Australian forests but has caused so little damage that it has not attracted the attention of the forestry authorities.
2. It has not been proved that *Sirex* is a dangerous forest pest.
3. The present quarantine restrictions are expensive and are ineffective in their operation. The only effective means of preventing the entry of *Sirex* would completely paralyse Australia's import trade. The timber position in Australia is such that imports of timber will be necessary until well into the next century, at least.
4. No other major timber-importing country has adopted quarantine measures similar to those at present in force in Australia.

5. The continuance of quarantine precautions may result in suppliers refusing to sell timber to Australia.
6. The quarantine precautions have been responsible for a heavy increase in freight rates to Australia. They have also caused considerable hold-up of ships, wharf congestion and delays to the clearing of cargoes.

IX. EXPERIENCE OF WOOD WASPS IN OTHER COUNTRIES

Experience in Europe

Through the agency of Mr. N. Tamblyn, of the Division of Forest Products, Commonwealth Scientific and Industrial Research Organization, Mr. G. J. Rodger, Director-General, Commonwealth Forestry and Timber Bureau, and Mr. J. H. Hillston, of J. H. Hillston & Co., replies to a series of ten questions regarding *Sirex* were received from eminent authorities in the United Kingdom, France, Germany, Austria and Roumania. These questions and replies are published in full as Appendix V to this report.

A summary of this information is given below:

(a) The most common species of wood wasps in Europe are *Urocerus gigas, Sirex juvencus* and *Xeris spectrum; Sirex noctilio* is relatively uncommon.

(b) Apart from the fact that all these species are restricted to conifers, it is not possible to recognize any very definite host preferences; both *Sirex noctilio* and *Urocerus gigas* are most commonly found in pines, but will also breed in a variety of other conifers. The former is reported to have a preference for smaller and younger trees, and the latter for older and larger trees.

(c) None of these species is regarded as a serious or primary pest of forests in Europe. It should be noted, however, that several of the authorities consulted by the Committee emphasized the difference between European forests and those in New Zealand and Australia. Certain European authorities considered that the usual prevailing low numbers of wood-wasps in European forests were due to the activities of the parasites of the genera *Rhyssa* and *Ibalia,* but there was not general agreement on this point.

(d) There was, however, general agreement that ecological factors are of great importance in determining the local abundance of wood wasps. For example they cannot thrive in trees that are in full and vigorous growth, but readily attack trees that have suffered an abnormal or sudden decline in vigour, whether these are growing as isolated trees or form part of a natural forest or a plantation. Examples of the more common causes for a sudden decline in vigour that were given include senility, any general weakening of the tree from the attacks of bark beetles and other insects or fungus, destruction or damage to roots by water-logging, fire, insect or fungal attack and physical damage by snow and wind. It is stated that wood wasps are not likely to increase in an area unless it contains many trees in the condition which favours their development. (This point is discussed further in this report under the heading "The potentialities of wood wasps as pests of Australian forests.")

(e) It is not usual in European forests for circumstances to favour the development of outbreaks of wood wasps. But several European authorities who were consulted mentioned an unusual abundance of wood wasps during the post-war years. This is ascribed to the unusual condition of the forests associated with neglect of silviculture during and after the war. On the other hand certain British authorities consider that wood wasps are less abundant in Britain than they were 20 years ago.

(f) The European authorities were not able to add anything of material consequence to Australian experience with respect to methods of destroying wood wasps in timber.

It is important to note that the presence of *Sirex* infestation in timber shipped from Europe to Australia has increased greatly within the last few years; this might be attributed to the following causes:

(i) Neglect of silviculture in European plantations during the war years;

(ii) Damage to trees through shell fire and other war causes rendering the trees more susceptible to *Sirex* attack;

(iii) An unprecedented world demand for timber creating a sellers' market, and enabling timber to be sold irrespective of quality;

(iv) The entry into the trade of shippers in Europe and importers in Australia who were unfamiliar with the Australian timber trade.

In connection with (iv) above a representative of the Royal Swedish Legation, Canberra, stated in evidence:

"The Swedish Government contacted the interested Swedish organizations, among others the Swedish Wood Exporters' Association, which made thorough investigations in the matter. It was reported that the obvious reason for the occurrences was the fact that the Swedish exportation of timber to Australia had suddenly increased from 18,000 standards in 1949 to 55,000 standards in 1950. Because of the considerably increased demand, the Australian importers had apparently contacted not only the regular circle of well-known wood exporters, but also a number of inexperienced enterprises. This was proved by the fact that only 29,000 standards, or about 50 per cent. of the 55,000 standards exported in 1950, were delivered by members of the Swedish Wood Exporters' Association, which covers the most important timber exporters in Sweden. Only one member of that Association had received complaints from an Australian importer regarding insect infestation in timber."

Experience in North America

The following species of the sub-family Siricinae are listed, by Doane, Van Dyke, Chamberlain and Burke in their book "Forest Insects," as being common in North America: *Sirex areolatus, S. juvencus, S. behrensi, Urocerus albicornis, U. flavicornis, U. californicus,* and *Xeris morrisoni.* The different species are stated to breed in a wide variety of conifers including Douglas fir, cypress, species of fir and various species of *Pinus.*

Although it is stated by these authors that the larvae of wood wasps sometimes do considerable damage it would seem that in North America, as in Europe, wood wasps are not regarded as serious primary pests of forests.

The Committee has made enquiries about quarantine precautions from authorities in both Canada and the United States. It appears that neither country has any specific quarantine regulations relating to Siricidae but when these or any other potential pests are discovered in timber by the Quarantine authorities they are destroyed either by burning or fumigation.

Experience in New Zealand

Miller[1] records that *Sirex noctilio* was introduced into New Zealand towards the close of the nineteenth century. It is known to have been present in the Rotorua district since before 1925 but there is no information about the distribution and numbers of the insect at that time.

(1) Bull. Ent. Res. Vol. 26, p. 149.

Some abnormal mortality in *Pinus radiata,* probably associated with *Sirex,* was noticed in 1940, 1944, 1945 and 1946 but this attracted little attention until about 1948. The most severe outbreak to date occurred during 1948-49. It is now clear that *Sirex* constitutes a serious problem and it is receiving a considerable amount of attention from the New Zealand Forest Service and other owners of plantations in New Zealand. Two recent publications viz.:—

"Recent Observations on the *Sirex noctilio* Population in *Pinus radiata* Forests in New Zealand"(1)—By G. B. Rawlings; and

"*Sirex noctilio* as a Beneficial and Destructive Insect to *Pinus radiata* in New Zealand"(2)—By G. B. Rawlings and Nancy M. Wilson.

have been freely quoted by witnesses in favour of intensification or maintenance of quarantine precautions and by those in favour of relaxation of quarantine precautions.

The Committee was accompanied by Mr. Rawlings in its visits to many plantations in the Auckland and Rotorua regions. It was also allowed to examine the records of the Forest Service dealing with field studies of the incidence of *Sirex* attack. The Assistant Director of Forests in the New Zealand Forest Service (Mr. A. L. Poole) tendered formal evidence as under to the Committee at Wellington. Attention is particularly invited to the third paragraph.

"The 'Australian *Sirex* Quarantine Committee' will have made many observations and received much evidence while prosecuting its inquiries in New Zealand. From the sifting of this it will be making deductions. As part of the evidence it has been deemed advisable to place before the Committee the official administrative attitude of the N.Z. Forest Service towards the problem of *Sirex* infestations in its own forests and the connection this has with the export of timber and the possibility of the insect reaching epidemic proportions in Australia. Many loose statements containing published quotations taken from their context, have been bandied about as representing the truth or the official attitude towards the problems involved. It is mainly to place these in their correct perspective that this statement is made.

"The administrative attitude is based upon a scientific knowledge, as far as it goes, of the insect and its depredations in New Zealand and upon accepted principles of forest practice.

"The New Zealand Forest Service deplores the presence of Sirex in New Zealand, where in some forests and under certain conditions the attack in epidemic form has seriously reduced the growing stock. The department would agree fully with Australian officials in taking all practicable quarantine precautions to keep the insect out of the Commonwealth forests.

"In New Zealand *Sirex* infestations have appeared mainly in the untended insignis pine forests of the central North Island although the insect is also distributed to some extent throughout the country. In these untended plantations, in which suppression becomes extreme, the insect has hitherto confined its attack to suppressed and malformed trees. While there is no guarantee that they will continue in the future to confine the attack to these classes of trees foresters regard the problem of control as one of forest hygiene and correct silviculture. Limited areas of treated stands in the centre of infestations have indeed shown this to be so. Therefore, as and when New Zealand is able to introduce sound forest practice so is the *Sirex* infestation expected to abate.

"The total elimination of the insect would of course be impossible so that quarantine measures taken in connection with timber exports will always have to be enforced.

" . . . . It is suggested that the recent abnormal interest about the insect has arisen because of the importation of badly infested timber from some European countries. Australian foresters who are familiar with European forest practice will be well aware of the causes leading up to the infestation of this timber. They are partly the same causes that apparently allow *Sirex* to become epidemic in this country. Periodically a succession of dry years allows insect infestations to become epidemic. The attack is both on the logs left lying in the stream beds awaiting another year's spring fresh for floating and on standing trees in the forest.

"When normal conditions rule on the timber market, logs badly attacked would not be converted to timber for export, but on the strong seller's market that has prevailed post war this has been done. With the passing of this dry period and the return of a buyer's market it is safe to assume that affected timber will not be there for export until another dry weather cycle occurs say in ten to fifteen years' time.

"As a matter of interest New Zealand research to date has tended to stress the importance of the dry season of 1946 in building up the *Sirex* population in the untended stands of the Rotorua region. It appears—from preliminary investigations only—that these soils will support a certain basal area under average climatic conditions. When these conditions fall below the average as regards moisture, *Sirex* reduces the basal area accordingly.

"The quarantine precautions taken to see that no timber containing live insects is exported from New Zealand have been outlined by Mr. W. C. Ward, Inspector-in-Charge, Commercial Division of this Service.

"The basis of these quarantine measures is as follows:

Sirex oviposits its eggs at a depth of about a quarter of an inch in the wood. In the sawing of logs, therefore, any unhatched eggs are cut off in the slabs. Newly hatched grubs remain for some time (up to the 3rd and 4th instars) at about the same depth; they would, therefore, also be discarded in slabs—bark may remain on kiln dried timber only, in which case eggs and grubs are killed. After that they move to a greater depth depending largely upon the moisture content of the wood. The larval boring at this time is visible, and after that up to emergence the tunnel is visible and detectable by the routine inspections required by law and described to you by Mr. Ward. In boards the fall in moisture content causes the larvae to die.

"If by chance adult insects emerged in any timber yards in Australia both males and females must be present in the immediate vicinity in which to oviposit. Such a chance set of circumstances is thought to be so remote as to explain why hitherto no recorded attacks on exotic stands in Australia have been noted."

(Note: In answer to questions Mr. Poole added that *Sirex* infestations had been found also over quite a range of species, mostly in *P. ponderosa* and *P. laricio,* but not to such a serious extent as in *P. radiata.*)

The Committee was given every facility to see the pine forests of New Zealand including some of the areas most badly damaged by *Sirex.* In one forest it was noted that many of the trees in which *Sirex* had been breeding included the largest in the stand, so whatever may have been their condition at the time when the *Sirex* larvae became established they must have been, not very long before, some of the most vigorous trees in the stand. One exceptional area was seen in a private plantation where in two years the number of trees had been reduced, through *Sirex* damage, to one twelfth, and where the volume of the timber had been reduced during the same period by more than three-fourths. The Committee was informed that in this area, during the last three years, the *Sirex* around the trees had been "like a swarm of bees."

The view was widely expressed in New Zealand that the epidemic was probably set in motion by climatic conditions favouring a rapid increase in the *Sirex* population. The opinion was also expressed that the recent outbreaks of

(1) The New Zealand Journal of Forestry, Vol. V, No. 5, 1948.
(2) The New Zealand Journal of Forestry, Vol. VI, No. 1, 1949.

Sirex could have been prevented had the forests been kept adequately thinned. In view of the history of afforestation in New Zealand and the present condition of the forests this opinion must remain no more than a hypothesis until it can be tested by experiment. For reasons set out more fully in the section headed "The potentialities of wood wasps as pests of Australian forests," the Committee considers that even if this hypothesis should eventually be verified for New Zealand it would still be unlikely to hold for the rather more severe conditions which prevail in Australia.

The Committee examined the position with respect to the biological control of *Sirex noctilio* in New Zealand. The parasite *Rhyssa persuasoria* was first introduced in 1928. It has since been distributed widely throughout the Dominion and at the present time its distribution more or less coincides with that of its host. Within the last few years a second parasite, *Ibalia leucospoides,* has been introduced but has not yet had time to prove itself.

The recent outbreaks of *Sirex noctilio* occurred despite the occurrence in the area of a well-established population of *Rhyssa.* This is not surprising. The potential rate of increase of *S. noctilio* is several hundredfold in one generation. Normally its numbers remain low because of a shortage of food, and the numbers of parasites remain low for the same reason. Given a sudden increase in the amount of suitable food, due to fire, drought or other causes, the numbers of *Sirex* may increase greatly and suddenly; the parasite inevitably lags behind. What is true of *Rhyssa* in this regard seems likely to be equally true of *Ibalia* or any other species of parasite. In other words the Committee formed the opinion that parasites were unlikely to exercise adequate control of *Sirex.*

The following figures concerning production and exports of exotic timbers from New Zealand are of interest:

Export Trade in Exotic Timber from New Zealand—in Million Super. Feet Units

Calendar Year	Total Export of Exotic Timber	Export of N.Z. Forest Service	N.Z. Production of Exotic Pine Timber
1941	1.6	0.8	56.2
1946	4.1	0.9	111.6
1951	20.3	6.7	220.0
1952	30.0*	10.0*	250.0*
1953	45.0*	12.0*	270.0*

* Estimated.

The area of exotic pine forests established in New Zealand as at 1951 was 795,000 acres (State — *P. radiata* 200,000, other *Pinus* 186,000; private companies — *P. radiata* 275,000, other *Pinus* 14,000; local bodies and private owners—*P. radiata* 110,000, other *Pinus* 10,000). In comparing sawn production from this area of 220 million super. feet (18.3 million cubic feet) in 1951 with approximately 100 million super. feet (8.3 million cubic feet) of exotic softwood produced in Australia in 1951, it should be noted that the New Zealand established exotic forests are estimated to have a potential sustained yield exceeding 175 million cubic feet, in the round, of which probably approximately 135 million cubic feet will be utilized as saw logs to produce ultimately above 800 million super. feet (66.6 million cubic feet) of sawn timber annually. The New Zealand pine forests are said to be growing at the rate of 10,000 tons of timber daily. Present production of timber is limited not by the amount of raw material but by shortage of labour, milling plant, handling facilities, shipping and markets.

At a meeting which the Committee had with the New Zealand Timber Export Council, Mr. W. C. Ward, Inspector in Charge, Commercial Division New Zealand Forest Service, and Mr. F. D. Morgan, Senior Timber Inspector, New Zealand Forest Service, explained to the Committee the system of inspection adopted to prevent any *Sirex*-infested timber being exported. This inspection service began in 1949. The Customs Department will not issue an export permit unless the Forest Service has signified its approval to the export. In respect of exotic timber this will not be given unless it has been inspected by one of the Forest Service timber inspectors and conforms to certain requirements. At the present time all export exotic timber, other than kiln dried, must be free of bark, insects or evidence of insect attack, and stain; except that stain may be admitted if in the opinion of the timber inspector it is superficial only, will not deepen during export, and could be removed in planing. In addition, timber other than kiln dried must be dipped in anti-sap stain chemical solutions soon after sawing to minimize the risk of stain development. Bark is permitted in kiln-dried timber, but the Forest Service, as the principal shipper of kiln-dried timber, endeavours to eliminate it completely.

Timber inspectors are employed permanently on inspection duties, which include frequent inspections of timber and conditions at export mills, in addition to inspection at port of export. Timber inspectors are instructed to report any evidence of sawing of logs containing insect attack or unsatisfactory yard conditions which might be expected to result in insect infestation. They will not undertake inspection of stocks which contain obvious evidence of bark or insect attack.

The rigid exclusion of bark was decided upon primarily to prevent the export of timber containing *Hylastes.* It is considered of value also in preventing export of timber infested with *Sirex.*

Inspection is done at the mill, and starts with the logs on the skids. Inspectors examine logs for insects and fungus, and care is taken to see that dead trees are not milled. Sometimes two inspectors are employed. The timber is cut and assembled about ten days before the ship is due to load. Timber must be free of bark. Timber cannot be guaranteed to be free of insects, but it is free of fungus and stain. The Forest Service likes to see timber green-dipped. The timber is again inspected as it goes on board the ship. Timber must be branded and trade-marked so that faulty timber can be traced back to the supplier.

The Committee's impressions of the *Sirex* problem in New Zealand may be summarized as follows:

(a) *Sirex noctilio* is widespread in plantations of *Pinus* spp. in New Zealand.

(b) It is relatively more abundant in the North Island than in the South Island. It has been numerous enough in certain areas during the period 1945 to 1949 to do severe damage to the forests. This increase was associated with a succession of years of sub-normal summer rainfall.

(c) *Sirex* has caused most damage in stands of *P. radiata,* but it has also affected other species including *P. ponderosa* and *P. laricio.*

(d) There is no doubt that *Sirex* attacks trees other than those which have been suppressed and which would normally have died.

(e) The activities of *Sirex* during the recent mass outbreaks in some plantations resulted in a net loss of timber. Although the trees that remained alive may have grown more rapidly than they might otherwise have done, the subsequent gain in volume per acre would, in many cases, be more than offset by losses from trees that had died.

(f) Thousands of acres of pines which were planted during the depression years are at present providing much more timber than can be milled and marketed; for this reason losses of trees by *Sirex* are not of such account as they would be in Australia with its inadequate softwood resources.

(g) Because of planting on such a huge scale it has been impracticable to thin the forests economically. This may have accentuated the damage done by *Sirex,* but there is not sufficient experimental evidence to support the suggestion that thinning could have prevented *Sirex* from multiplying to epidemic proportions.

(h) Although the parasites *Rhyssa persuasoria* and *Ibalia leucospoides* may help a little by reducing the numbers of *Sirex* in between large-scale outbreaks, they are not likely to provide adequate control of the pest or to prevent such outbreaks.

(i) All timber millers and foresters interviewed stated that they would prefer not to have *Sirex* established in New Zealand. Even those who discounted the seriousness of *Sirex* as a pest agreed that the provision of safeguards against the insect was costly, and that although *Sirex* often resulted in the removal of suppressed and unhealthy trees, it was safer to have this work done by human agency.

X. THE POTENTIALITIES OF WOOD WASPS AS PESTS OF FORESTS IN AUSTRALIA

We do not know enough about the biology of the various species of Siricidae to express an opinion as to which species would or would not be most likely to thrive on *Pinus radiata* in Australia. It is at least clear, however, that one species (*S. noctilio*), which did not come originally from *P. radiata,* has been able to adapt itself to this tree in New Zealand, and there is no evidence to suggest that other conifer-inhabiting species from the Northern Hemisphere could not do the same in Australia. On the other hand there is clear evidence that *Sirex noctilio* has become adapted to living in *Pinus radiata* in the Southern Hemisphere in a climate that more nearly resembles our own. During the four or five decades that *S. noctilio* has been in New Zealand natural selection has doubtless been proceeding, with the result that the population now in that country is possibly better adapted both to *Pinus radiata* and the southern climate than were its progenitors on their arrival from the Northern Hemisphere.

Therefore in considering the danger in allowing wood wasps to enter Australia in imported timber and crates the Committee has paid special attention to *Sirex noctilio,* while also including all other species which may be imported in softwood timbers. On the other hand relatively little attention has been given to pests of hardwood timbers. Species of the genus *Tremex* or others associated with hardwoods may occasionally reach Australian ports, but imports of hardwood timber are so small and our main indigenous hardwood species are so different from all broad-leaved trees of the Northern Hemisphere that the risk to our hardwood forests from wood wasps seems remote.

The following brief account of the biology of *Sirex noctilio* and related species is drawn partly from the scientific literature on this subject, partly from observations and discussions during the Committee's visit to New Zealand, and partly from evidence submitted at the public inquiries held by the Committee in Australia and New Zealand.

Trees are damaged by *Sirex noctilio* in two ways, and it seems likely that the same is true of other species of Siricidae. The larvae make tunnels in the wood which detract from the value of the timber, and the adult female, in the process of oviposition, inoculates the tree with the spores of a fungus which also detracts from the value of the timber and may, in certain circumstances, kill the tree. A very close and necessary relationship exists between the wood wasp and the fungus. The larva of the wood wasp cannot exist and grow except in wood that has been attacked by the fungus, while the fungus has no means of dispersal except through the wood wasp. A subtle mechanism has been developed whereby the fungus that has been ingested by the larva is transferred to special glands in the adult which are associated with the ovipositor. Each time she drills a hole through the bark with her ovipositor she injects some spores of the fungus into the tree. The hole penetrates to about the level of the cambium, and this is where the eggs are placed. But not every hole receives an egg. Rawlings[1] estimates that the number of eggs laid may be as low as one to every ten holes bored. Thus a female which laid 200 eggs during her lifetime might be responsible for 2,000 inoculations with fungus spores. Not all these inoculations "take". In certain circumstances they virtually fail, and all that can be found on examination is a "pin-point" of dead tissue around the puncture. In other circumstances the fungus may grow vigorously resulting in the death of a strip of wood several feet long and several inches wide. The tissues that are first killed by the fungus are the cambium and adjacent tisses in which the vascular bundles are situated. The vascular tissues are responsible for the transportation of the sap to and from the roots so that if the tree should be encircled by *Sirex*-killed wood it quickly dies. In order to understand the risks associated with the presence of *Sirex* in the forest it is necessary to consider not only the biology of *Sirex* and its associated symbiotic fungus but also the physiology of the pine tree in relation to the all-important question: "In what circumstances does the pine tree become favourable for the development of the *Sirex* grub and its associated fungus?"

The adult wasps feed little if at all. The males tend to congregate around the tops of the trees. The females, after they have mated, descend to the main trunk and spend most of their time ovipositing, particularly in warm bright weather. The following brief account of the behaviour of adult *Sirex noctilio* is quoted from Rawlings[1]:

> "In the Rotorua district *Sirex* begins to emerge about the middle of December; the males appear first and the females a few days later. The main emergence takes place in February, at which time they collect like swarms of bees in the tree-tops where copulation takes place. The mature female is governed by an intense urge to bore. This instinct is in excess of her capacity to lay eggs, and in consequence more oviposition punctures are made than there are eggs laid.
>
> "The female selects a suitable site, usually the trunk of a living tree, and proceeds to bore oviposition holes at the rate of one about every five or ten minutes. She usually proceeds from low down on the trunk and works upwards, boring into the stem every few inches; on reaching a certain height up the tree she flies down again and the process is repeated. The length of trunk worked over may vary considerably, and there is a tendency to concentrate on the more exposed portions below the lowest green branches, particularly if exposed to the sun. The number of eggs deposited may be as low as one to every ten holes. The cambium surrounding the punctures discolours very quickly, suggesting the action of some chemical which may also stimulate the flow of resin. From each puncture a stream of resin flows down the trunk often for a distance of several feet, and globules of resin form at the end as the resin hardens. The smell of this resin appears to attract other *Sirex,* and these combine in a mass attack on the tree. In each puncture, whether an egg is laid or not, spores are deposited and a fungus develops which damages or kills the tree. Females continue boring until they are exhausted, and many die with their ovipositors fixed in the trunk. It is recorded that the ovaries contain 400 eggs. Following mass attack, exit holes, which tend to be more frequent on the southern side of the tree, may number more than 200 to a square foot of bark. This concentration of larvae means an even greater concentration of initial fungus infection, and explains the extremely rapid dying of the trees."

(1) New Zealand Journal of Forestry, Vol. 5, No. 5, 1948.

It is often said that *Sirex* is attracted to "sick" trees. This is a loose statement which should not be taken literally. On the contrary the females seem to have very little discrimination as to where they lay their eggs. As Rawlings says, they seem to be "governed by an intense urge to bore", and will place their eggs into almost any tree or log wherever they happen to be at the time, even into freshly-sawn timber. (See appendix V.) But the females nevertheless do not lay their eggs at random, for they are strongly attracted by the odour of fresh resinous exudations, and they tend to congregate on trees that have been damaged, as for example by pruning or wind, or on freshly-felled logs, and (as Rawlings points out in the passage quoted above) on trees that already have some females ovipositing on them. In certain circumstances this leads to a majority of the eggs being placed into trees that are "sick" or are otherwise favourable for the survival and development of the eggs and larvae; but in other circumstances the reverse is true. This fact, as is shown later, may be important in relation to the development of outbreaks of *Sirex,* and the severity of the damage it may do to pine forests.

The Committee was unable to obtain precise information about the powers of dispersal of *Sirex,* that is, the distance it might be expected to fly in search of somewhere to lay its eggs or in response to the odour of fresh resin. Clearly this is important in relation to the likelihood that a *Sirex* female, escaping near the waterfront or in some place where conifers were scarce, would be able to find a suitable tree in which to lay her eggs. The best answer that can be given to this question at present is to say that the distance would probably have to be measured in miles rather than in chains or furlongs. This conclusion is based on the following observations:

(a) The wood wasps are large as insects go, and by general consent are reckoned to be powerful fliers.

(b) It is general experience that when trees are being felled *Sirex* will appear fairly quickly, sometimes apparently from a considerable distance.

(c) In New Zealand *Sirex* is widely, almost universally, distributed, even in isolated shelter belts of pines which are many miles from the nearest host trees.

This indicates rather high powers of dispersal, and emphasizes the need for even greater caution than with, for example, a disease organism that can be spread only by contagion.

The immature stages of *Sirex,* i.e. the egg larva and pupa, all spend their entire life inside the tree. The eggs are placed just under the bark on or near the cambium. Normally the great proportion of these (probably well over 95 per cent.) die either as eggs or as very early-stage larvae because they have been laid into unfavourable situations. Those that are better situated hatch after about a month. The grub feeds at first near the surface, but later bores more deeply into the tree. The tunnel is enlarged as the grub grows, so that by the time it is reaching maturity the tunnel may be about one-fourth of an inch in diameter. The larva on reaching full-size changes to a pupa, which in due course gives rise to the adult. The adult chews its way to the outside, leaving as a rule a perfectly circular exit hole about the same diameter as a small lead pencil. (See figure 10.) In Europe the life-cycle of most species of Siricidae is said to occupy from one to three years, with most individuals taking two years. In New Zealand some individuals of *Sirex noctilio* seem to require three years, but most probably complete the life cycle in one year.

In Europe *Sirex juvencus* and *Urocerus gigas* are regarded as relatively common insects, and *Sirex noctilio* is considered as normally quite a rare species. But none of them is regarded seriously as a pest of forests. This is because in the circumstances prevailing in Europe they do not normally multiply to the great numbers that may result in severe damage to the forest. In New Zealand *Sirex noctilio* is a common insect occurring throughout the Dominion almost wherever pine forests are growing; and there are extensive areas of forest in New Zealand, especially in the South Island where *Sirex noctilio,* like the related species in Europe, has not as yet been observed to multiply to plague numbers. On the other hand in the Rotorua district of North Island it has been known, on occasion, to multiply to vast numbers and do severe damage to considerable areas of forest. The Committee has sought an explanation both for the relatively low numbers characteristic of some areas and the capacity to produce plagues in others in order that it might give a well-considered answer to the question: "If *Sirex noctilio,* or some related species of wood wasp, became established in Australia, would it be likely to do severe damage to our pine forests?"

One theory[1] that has been put forward attributes the relative scarcity of *Sirex* in Europe and in some parts of New Zealand to the presence of parasites, e.g. *Rhyssa, Ibalia.* The Committee is unable to place any confidence in this conclusion, particularly in view of the experience in the Rotorua district of New Zealand where *Rhyssa* has been present since shortly after 1928, yet it did not prevent a very serious outbreak of *Sirex* in 1948-49. Moreover, there is a number of theoretical considerations which make it unlikely that parasites would be effective in preventing violent fluctuations in the numbers of *Sirex* in an area where other circumstances sometimes favoured its rapid multiplication. The most important of these other circumstances is the condition of the pine trees in relation to the weather and soil. The following is a brief discussion of this point in relation to both New Zealand and Australian forests.

It has been stated that the female of *Sirex noctilio* may lay as many as 400 eggs. If a relatively high proportion of these survived in any one generation the insect would be very much more abundant in the next generation. If the high survival rate were maintained for several successive generations enormous numbers might be produced with consequent severe damage to the forest. Rawlings has shown that eggs that are laid into trees that are vigorous, frequently —in fact usually—fail to develop. It is said that this is due partly—perhaps chiefly—to the failure of the fungus to become established in these circumstances, but also partly due to the fact that the eggs may find the condition of the tree unsuitable. On the other hand a high proportion of the eggs that are laid into trees that have recently lost vigour survive and complete their development. The Committee was unable to define more precisely than this just what constitutes a condition of the tree favourable to the development of *Sirex.* Although this is perhaps the most important single piece of information that might be sought about the biology of *Sirex,* it would seem that so far this matter has not been very thoroughly investigated.

It is, however, clear that the condition which favours the multiplication of *Sirex* does not necessarily occur in all trees that are "sick" or unthrifty. Several clear examples of this were seen in New Zealand. The Committee was shown, by courtesy of the New Zealand Forest Service, a number of situations where *Pinus radiata,* and other species, had been planted in the early days on sites that had turned out to be quite unsuited to them. The trees were "sickly", and in some places were sparse, having failed badly to take possession of the site. A small population of *Sirex* persists in these plantations, but there was no evidence that it had ever become very abundant. On the other hand plagues of *Sirex* had occurred in plantations that were relatively well-grown and in which the trees, for at least most of their development, had been vigorous and reasonably thrifty. A severe outbreak of *Sirex* occurred during the period 1947-49 with the numbers reaching a maximum during February, 1949. This outbreak followed and was associated with several years of unusual summer drought. Rawlings and Wilson[2] give the following figures for the rainfall at the

(1) H. S. Hanson, Bull. Ent. Res., Vol. 30, p. 27. See also evidence given at Committee's inquiry by Mr. L. H. Baigent.

(2) New Zealand Journal of Forestry, Vol. VI, No. 1, 1949.

headquarters of the Kaingaroa Forest. The average rainfall for the three-monthly period December to February is 13.20 inches. The rainfall recorded for these three months in 1945-46 to 1949-50 was:

1945-46	-	3.69 inches
1946-47	-	6.60 „
1947-48	-	10.80 „
1948-49	-	9.00 „
1949-50	-	13.02 „

Isolated trees having a large area from which to draw their water supply, or small unthrifty trees growing sparsely, may not have been very adversely affected by this drought, but the more vigorous trees growing as a dense forest community undoubtedly received a severe, if temporary, setback each summer during these years of drought. During this period a high proportion of the eggs laid by the *Sirex* females survived, with the result that the pest increased rapidly in numbers during two or three successive generations. It may be concluded from this example that the best general definition that can be given of the tree in which the condition is favourable for the breeding of *Sirex* is the one which, having been fairly vigorous, has recently suffered a severe setback to its general metabolism. This conclusion is confirmed by general experience of *Sirex* in Europe and elsewhere. (See appendix V.) For example, it is known that trees that have been scorched but not killed by fire become favourable for the breeding of *Sirex,* as do trees that have recently received a check from fungal attack of the roots, water-logging of soil, and so on. The extreme case is the vigorous tree that has just been felled, and it is well-known this offers favourable breeding places for *Sirex.* Drought, fire and disease are perhaps the most likely hazards that mighth cause a forest or part of it to become favourable for the breeding of *Sirex.* This may happen to a sickly or unthrifty tree, but, for reasons that have already been mentioned, it is also likely to happen to trees that are growing as a vigorous forest community, particularly on certain soils and in climates where drought is likely. This conclusion has an important bearing on the question of just how serious *Sirex* might become were it to be established in Australian forests. This will be discussed below, but consideration must first be given to one other aspect of the epidemiology of *Sirex* in those places where it is already established.

In the absence of a widespread disaster such as drought, fire or disease, a forest may be expected to contain relatively few trees that are in a condition to support the immature stages of *Sirex.* Even so, if the females were highly discriminating they might by seeking out such trees and concentrating their eggs in them, be able to maintain quite high numbers even in a normal forest. However, as has been stated above, such powers of discrimination are not very highly developed in *Sirex*; instead the females lay their eggs much more promiscuously, with the result that a very high proportion of them come to nothing because they are placed in situations where they cannot survive. As a result the rate of increase is low and the general level of abundance of the population may remain low until such time as a general disaster such as drought, fire or disease overtakes the forest. Once this has happened the *Sirex* find themselves in circumstances quite different from those in which they were. There may be considerable areas of forest in which almost every tree is a favourable breeding place for *Sirex.* The females need not be very discriminating, and yet succeed in placing most of their eggs in places where they will thrive. The potential rate of increase in one generation is, as has been seen, about two-hundredfold; this is hardly likely to be fully realized even in the most favourable circumstances, but the actual rate of increase may nevertheless be enormous.

The damage done to the forest during an outbreak of *Sirex* may be considered from two aspects. The outbreak may owe its existence to the presence of many trees that had already suffered a setback from some other cause. Some of these may have died in the absence of *Sirex,* but *Sirex* may kill many trees that would otherwise have recovered from the original setback. In addition to this, once the outbreak is well under way *Sirex* may kill other trees that are vigorous and were not primarily in a suitable condition for attack. Such trees might be quite immune from the attacks of few *Sirex* yet succumb to the attacks of many. This is due to the following succession of events:

(a) As was stated above the female of *Sirex noctilio* may drill as many as ten times as many holes as she lays eggs. Into each hole she injects fungus spores irrespective of whether there is an egg in it or not.

(b) Because gum exudes from the oviposition punctures the presence of one female on a tree attracts others, and thus the ovipositing females tend to congregate on particular trees.

(c) This mass attack may so weaken the tree, at least locally, that the fungus may become established in some places, thus paving the way for the *Sirex* larva.

Thus *Sirex,* once an outbreak is well under way, may kill not only the trees have have been temporarily distressed by some other cause, but a proportion of strong and vigorous trees as well.

In Australia afforestation with exotic softwoods, chiefly *Pinus radiata,* has made great progress, but the industry is not without its problems. It would be fair to say that the thorough scientific investigation of these problems is still in its infancy. In all the mainland States where pine plantations have been developed there are substantial areas in which the trees are liable to manifest a variety of disorders. These may be associated with the type of soil and the weather, and there is also clearly a relationship between the age of the trees and their susceptibility to certain disorders which is probably related not so much to age as such, but rather to the age at which the community of trees tends to fully occupy the site. This may also be a partial explanation for the observed interaction between all three factors, soil, weather and age of tree. Certain disorders may be prevented or alleviated by the appropriate manurial treatments, but even in these cases the fundamental causes of the disorders have not been discovered. Briefly, this adds up to the fact that in all the Australian forests of exotic pines there are substantial areas which may be expected from time to time to manifest disorders and setbacks in response to unfavourable weather and other causes not very well understood. Since susceptibility tends to be related to age, and since trees of uniform age occur in blocks (or compartments) it follows that whole blocks of trees may become favourable for *Sirex* at the same time. This, as has already been shown, is one of the circumstances which favour the development of an outbreak. In Australia the risk from fire is greater than in New Zealand or Europe, and it has been shown that blocks of trees that have been scorched, but not killed, by fire also favour the rapid multiplication of *Sirex.* Also it must be recalled that in most parts of Australia where pines are grown the summer is hot and dry, and it is probable that in Australia the normal summer is at least as arid as the most severe drought ever experienced in New Zealand pine plantations. We do not have any precise information on the physiological responses of the pine tree to summer drought, but the possibility cannot be overlooked that in Australia every year might provide some situations where the mass reproduction of *Sirex* is possible. In New Zealand *Sirex noctilio* is able to maintain much higher numbers than in Europe. In Australia it may be able to maintain even higher numbers than in New Zealand. At the Committee's inquiry Mr. S. Allman and Mr. D. W. R. Stewart gave several examples of other species of insects which, while being relatively rare and comparatively innocuous in their native home, have become very serious pests when transported across the ocean or some other barrier to some entirely new environment. The examples quoted are far from exhaustive. Any

entomologist would have no difficulty in adding further examples to this list.

It would seem that all the indications point to the conclusion that were *Sirex noctilio* or some related species to become established on the Australian mainland, there would be considerable risk that it would do severe damage to the forests of exotic pines, and it might well become a more serious pest in Australia than it is in New Zealand. For these reasons the Committee has formed the firm opinion that it would be most undesirable to risk the introduction of *Sirex* into the forests of the Australian mainland.

At present it is known that *Sirex noctilio* has become established in one plantation in Tasmania, but there is no evidence of any species having become established on the mainland, despite the fact that larvae and adults of various species of Siricidae have been repeatedly found in imported timber in the ports, and some, undoubtedly, must have escaped detection and destruction by the quarantine authorities. It is, therefore, appropriate to consider certain aspects of the biology of *Sirex* which will help us to understand what influences the chances that an escaped wood wasp will be able to establish progeny in a new territory.

In order to produce female progeny a female wood wasp must be mated. Mating usually takes place in or above the canopy of the pine tree. Whether it could also occur in such "unnatural" situations as the hold of a ship or a shed on the wharf is not known, but it is rather doubtful. The male, on emerging from the pupal burrow in the log or tree (or in the present case in sawn timber), seeks a pine tree, remaining among the topmost branches for the rest of his life. The female at first also seeks the same situation. After she is mated she flies down to the trunk and proceeds with oviposition. If the condition of the tree happens to be favourable many of the eggs may develop and contribute to the next generation, but if it is not then most, or perhaps all, will die.

Thus, in considering the probability that a wood wasp, emerging from a piece of imported timber somewhere in Australia, may leave behind some progeny to carry on the next generation, we need to consider the probability of the following events happening. A female must find her way to a pine tree, and during her lifetime (which may be no more than a week or two, since she does not feed in the adult stage) a male must find his way to the same tree. The trunk of this tree or some other which the female subsequently finds must be suitable for her progeny. Sufficient of these must survive to give the next generation a chance of propagating itself; that is, at least one pair of opposite sexes must emerge at the same time, or with a sufficiently small interval separating their emergences to ensure that they come together for mating.

It is clear that it is not possible to provide a quantitative estimate of any of these events happening, but it may be helpful to consider very briefly the general principles involved. It is useful to consider the situation in which one male and one female are liberated in the same area about the same time. If there are many trees in the area then the chance that each will find a tree may be high, but the chance that both will find the same tree may be quite low. Conversely, if there are few trees in the area the chance that each will find a tree may be low, but if each does find a tree then the chance that both may be on the same tree may be quite high. The conclusion to be drawn from this is that provided there is at least one tree in the area there is no great advantage to the wood wasps in having many trees there. But, of course, it is clear that in either case unless both sexes are liberated within obvious range of the *same* tree their chances of coming together must be considered quite small. We have already seen above that the female is not provided with any unerring instinct for laying her eggs in places where they have a good chance of surviving. Consequently it is largely a matter of chance whether the eggs are placed into a tree which will favour their development; and this chance may be considered quite small. In the light of all these considerations it is clear that the scales are weighted fairly heavily against the establishment of *Sirex* in new area when only a few individuals are escaping into it at infrequent intervals. It may be quite another matter if the escapees are numerous.

The insect has already become established in Tasmania. If, as seems likely, it should turn out to be impracticable to achieve absolute prevention of the entry of any *Sirex* into the mainland, then it seems quite clear, on the above reasoning, that it will be well worth while to take all practicable steps to reduce the number of wood wasps entering the mainland, from all sources, to the barest minimum.

The Committee realizes that even if this were done there still remains the chance that Sirex may eventually become established on the mainland, and this section will therefore be concluded with a brief consideration of those aspects of the biology of *Sirex* which are relevant to the amelioration of damage to the forests by a population of *Sirex* that has become irrevocably established in an area.

It is sometimes stated that in Europe and North America the various species of Siricidae are kept in check by parasites, and this is advanced as the chief explanation for the failure of wood wasps to become serious pests in those countries; species of *Rhyssa* and *Ibalia* are mentioned as the most important parasites, but there are also others. In Europe, however, entomologists are not unanimous in accepting this explanation(1), and for this and other reasons the Committee places little confidence in it. There is certainly no reason to believe that *Sirex* could be prevented from doing serious damage in Australia by the introduction of parasites of any sort.

In New Zealand the Committee found that many were inclined to the belief that *Sirex noctilio* could be controlled by "thinning" and other silvicultural practices. There is as yet no evidence for this belief. In Europe similar arguments have been challenged by Hanson.(2) There are substantial grounds for doubting whether *Sirex* could be so controlled were it to become established in Australia. Thinning is practised in order to allow the remaining trees to continue healthy development. Thinning does not destroy the essential quality of the forest community, namely, that the trees should fully occupy the site and make a good canopy cover. Thinning does not, therefore, remove the hazard of occasional drought or fire. Disease which has been listed, along with drought and fire, as one of the chief hazards likely to make Australian pine forests susceptible to mass outbreaks of *Sirex,* is not greatly influenced by thinning. It is clear from what has been said above that the most important single factor influencing the abundance of *Sirex* is likely to be the condition of the trees in the forest.

XI. FUNDAMENTAL FORESTRY RESEARCH

The *Sirex* wasp attack on exotic pine plantations which has developed in New Zealand focusses attention on the need for care in the maintenance of forest hygiene in Australian softwood plantations.

Grievous and persisting economic consequences may follow the entry from overseas and establishment in this country of some new pest affecting plants. Some sacrifice is necessary to prevent this, and aside from mere material interests there is a call to all persons ot take care as far as possible not to bring to Australia plant material which may be infested with some pest.

The defensive resources available to the country in Plant Quarantine cannot ever be said to be thoroughly effective in ensuring the detection and subsequent destruction of any contaminated material. This is equally the case with timber imports. By chance, despite the precautions taken and the vigilance of Quarantine Officers, some pest may gain entry.

It is to be expected, however, that not only will the risk of entry be greatly minimized through orthodox quarantine, but also that, through awareness of the danger and knowledge of the possibilities, quickness of attack on any

(1) Munro. Emp. For. Journ., Vol. 10, p. 209.

(2) Bull. Ent. Res., Vol. 30, p. 27.

introduced pest will greatly enhance the chance of its eradication before it can be firmly established in our country.

The Committee invites the attention of the Commonwealth Government to the desirability of instituting studies of the fundamental factors underlying the growth of exotic trees in Australia. This would ensure that basic information would be available should the necessity arise to deal with any pest which may similarly be imported into Australia.

It must be conceded that so far, apart from the *Sirex* outbreak in Tasmania, no serious insect or fungal attack has yet developed in Australian plantations; but the forester faces constantly the danger inherent in the growing of pure crops of an imported species. The experience of New Zealand shows that insects free from the restraint of their natural parasites and developing under particularly favourable climatic conditions do cause widespread damage before adequate control measures can be determined and applied.

It is found with any insect pest that the extent of the infestation depends upon the presence of predisposing factors. Unhealthy and dead trees in a forest are always possible sources of insect and fungus infestation. Deaths will occur in young forest stands of any species in the course of their struggle for existence, and the early removal of such trees is a commonplace practice of sound forest hygiene. In the establishment of exotic species in any country on a large scale, however, it is practically impossible to avoid comparatively extensive unhealthy stands or patches of plantations occurring.

Disease control in forestry in Australia, or rather disease investigation, has so far had to rely upon agricultural pathologists and entomologists, and in the past in Australia much of our disease control methods has been adapted from the practices employed in other countries.

The development of methods involving variations based upon detailed information of the operations of a particular pathogen as it behaves under Australian conditions is an outstanding need in Australian forestry.

Owing to the paucity of fundamental information in Australia on the relationship between site factors and the growth of coniferous species, and the scantiness of reliable data on the nature of the site factors themselves, it is not possible to say with sufficient authority what are the predisposing factors leading to abnormal behaviour in any pine crop here.

Basic information of this type is a prerequisite in planning any remedial measures in the event of an onset of predators in our forests and plantations, and the procurement of this information is a problem common to all States of Australia. It would indeed be a dissipation of effort, finances and skilled workers for the individual States to carry out such fundamental work, and in fact it is beyond the resources of some of them. For that very reason one of the functions of the Commonwealth Forestry and Timber Bureau is the carrying out of fundamental research in forestry. There is some cause for concern that the Bureau is not, because of lack of staff, performing this function to the degree necessary for the safety of Australian plantations.

In answer to questions by the Committee the Director of the Commonwealth Forestry and Timber Bureau, who appeared as a witness at the inqury, stated that, although it was originally intended that research should be one of the functions of the Bureau, the amount of research at present being carried out on growing pine was very small. The reason for such little work being done was largely due to the non-availability of trained staff. He considered that it would be much better for research work of this nature to be carried out by the Bureau rather than for individual States to attempt it.

There is already a considerable amount of literature written in Australia on the nutrition of pine trees. This work has of necessity been so far largely of an empirical nature, and can be only a first step in a long-range plan. The vigorous prosecution of fundamental studies is necessary if the existing and future stands of softwood timber in Australia, and possibly our own native forests, are to be adequately protected, and their present and potential wealth made available to our people.

XII. CONCLUSIONS

As a result of the evidence given at the public inquiries and its investigations in Australia and New Zealand the Committee has unanimously reached certain conclusions, set out in this section of the report.

1. Australian Forests and Plantations represent a Valuable National Asset

In comparing the value of Australian plantations with the cost of preventing the entry of *Sirex* and other pests into the country present values and costs are of little use. A valuation of the present stands of pine in Australia would represent only a part of the ultimate worth of pine-planting to Australia. Similarly it is of little use to show the present volume of timber imports into Australia and the cost of treatment of any percentage of that timber. Australia has insufficient timber for her present-day needs, and has always relied upon imports to supply her requirements of wood in full. With the expected growth in the Australian population in the future, this discrepancy between supply of Australian-grown timber and total timber requirements will widen unless more timber is grown in Australia.

Australia should not, of course, rely indefinitely on timber imports to meet her needs in a primary product. Having regard to Australia's comparatively small area of natural forest, the one way to assure these supplies is by intensification of the management and protection of her existing native forests and by a greatly expanded afforestation or pine-planting programme.

The growing of pure crops of coniferous trees is attended with many difficulties related to climate and soil, and the ever-present danger of introduction of some insect or fungus pest. These may imperil not only the introduced trees in the plantation, but may possibly then extend their activities to our forests of native softwood.

2. Australian Plantations must be Protected

Since timber, crates and boxes will continue to be imported into Australia from countries where *Sirex* occurs, and since no inspection service can hope to be infallible, it is inevitable that some wood wasps will continue to gain entry into Australia. It was shown earlier that there is only a somewhat remote chance that any individual wood wasp will meet with all the favourable circumstances that are necessary before it can establish its progeny in a new country. The risks associated with the escape of an occasional wood wasp are therefore not so very great. But the risks associated with the frequent escape of many wood wasps may be inestimably greater. The Committee therefore urges that every possible precaution be taken to discover and destroy any wood wasps that may be present in timber, crates or other wooden articles entering Australia from countries where *Sirex* wood wasps are known to occur. It should be the aim of the quarantine service to ensure that if any do escape detection then their number should be negligibly few.

There are other forest pests which it is quite as desirable to keep out of the country as *Sirex*. These include the bark beetles, and, because of the possible presence of these beetles, foresters and quarantine officers are very perturbed at any timber (including casing) being imported with bark adhering to it. Although its reference is limited to *Sirex* the Committee urges that all possible steps, even at some little inconvenience to importers, be taken to keep out of Australia not only *Sirex* but also all other forest and timber pests. The introduction of timber carrying bark should not be permitted.

3. Trees are Killed or Damaged by Sirex

Conflicting opinions on the question of what damage *Sirex* does in the forest were expressed before the Committee at its public inquiry, at private discussions and during its visit to New Zealand. In Europe and America *Sirex* is not regarded very seriously by forestry or entomological authorities. It appears to be accepted as a wood-boring wasp which attacks trees weakened in health or damaged by external causes, such as wind and snow. With its natural enemies, particularly the parasitic wasps, a balance is maintained and there is no record of its reaching epidemic proportions, but several authorities quoted in Appendix V consider that *Sirex* has been more prevalent in Europe in recent years than it is normally.

In New Zealand, where *Sirex* was introduced many years ago, it has quite recently made intensive attacks in some plantations; in other plantations it has acted in much the same manner as in Europe or America.

Although the intensive attacks in New Zealand have been restricted to a comparatively small area they have, in the opinion of the authorities, been definitely associated with what are regarded in New Zealand as dry seasons. The Committee could not contemplate, with equanimity, damage to a similar degree in Australian plantations where, during the summer, trees must grow under much drier conditions than in New Zealand.

In New Zealand *Sirex* was originally regarded as of little silvicultural consequence as it confined its attack to weakened trees which would ordinarily be removed as thinnings. In New Zealand, however, the forests are of such dimensions and of such age groups that it is virtually impossible to thin them economically by ordinary methods. Any thinning of *P. radiata* forests in New Zealand that has been done by ordinary methods has resulted in financial loss as no market can be found for the thinnings. In these circumstances *Sirex* was looked upon as a silvicultural asset in removing smaller and undesirable trees, but now the opinion is held by many in New Zealand that, at least in some areas, *Sirex* is definitely a forest pest causing extensive damage and financial loss. A representative of one New Zealand timber milling company expressed the opinion that "if trees must be removed it is safer to do it by a human agency."

The Committee has no hesitation in saying that in Australia, where plantations are insufficient to provide enough timber for Australia's softwood requirements—thus necessitating the use of all thinnings—*Sirex* would definitely be be a forest pest.

4. Timber is Damaged or Degraded by Sirex

Notwithstanding the opinions expressed by European authorities, as mentioned in Section IX of this report, any wood-boring insect which will cause degrading of timber by tunnelling must be considered to be a timber pest. Standing dead trees were seen in New Zealand riddled by *Sirex,* and in some cases the flight holes of the insects almost covered the surface of the bole. Fire or storms can cause severe damage to a plantation, but it is usually possible to salvage quite a considerable amount of the fire-killed or storm-damaged timber. On the other hand trees killed or damaged by *Sirex* are almost a complete loss in so far as either no market can be found for the timber, or if one can be found the timber must be sold at a very much reduced price.

In addition to its use as sawn timber, plantation-grown pine is now sought as the raw material for a number of Australian secondary industries. Possibly the most important is the manufacture of paper pulp, but there are others such as the manufacture of matches, plywood and other industries using pine veneers. A witness representing an Australian manufacturer of matches gave evidence that timber infected with fungus or boring insects would be entirely unsuitable for the production of matches. It was pointed out that the present supply of suitable peeler logs was insufficient to meet Australian requirements, and that the introduction of a pest such as *Sirex* into the forest would reduce the supply still further.

At the Committee's inquiry Mr. J. D. Brookes, representing an Australian manufacturer of paper pulp, expressed the opinion that *Sirex*-killed timber would be of little use in the manufacture of paper pulp. The following are extracts from this witness's evidence:

"This programme of integrated use of plantation products could well be seriously upset by a severe *Sirex* attack. First thinnings, etc., even if salvageable soon after death, would be severely affected by the symbiotic fungus associated with *Sirex* (*Stereum* spp.). This fungus, which causes the death of the *Sirex*-infected tree, is classified as a white rot, that is a fungus which attacks both lignin and cellulose, but frequently decomposing lignin more rapidly than cellulose.

"Fungus-attacked wood does not produce a pulp of such high quality as clean wood. Degrading is about proportional to the severity of the fungal attack. This applies to both mechanical and chemical pulps.

"One of the most important effects is the reduction of the vital tear strength of the pulp. Thickens[1] showed that the pulp is weaker, darker in colour and of shorter fibre length, and that it loses more strength during storage than does pulp made from clean wood. Kress and others[2] showed that yield is reduced substantially when fungus-attacked wood is cooked or ground.

"Our ground wood pulp is produced mainly for high-grade cardboards, etc., where quality is of great importance, so it is only natural that we should view with concern the possibilitiy of having to use inferior quality pulpwood.

"On the chemical pulping side the situation is much the same. Bjorkman and others [3] found that pulpwood affected by fungus gave lower yields per unit of pulpwood and poorer quality pulp than clean wood. Again vital tear strength showed great reductions. The lower yield per unit of pulpwood is of great importance. When combined with the fact that alkali, the cooking liquid, is wasted in cooking rotten wood, it becomes very serious. Wastage of alkali is important itself because of the difficult supply position and the high cost.

"If our plantations are to be economic they must produce a long-fibred pulp at least equal in quality to overseas long-fibred pulps, otherwise our products will not be of good quality. Clean mature *P. radiata* wood has already been proved to make a kraft pulp comparable in quality to overseas long-fibred pulp. I refer there to tests of cooks made by us of New Zealand timber. We have, however, no margin to work on. Any degrading in quality or reduction in yield per unit of pulpwood in locally-produced long-fibred pulp would be serious."

5. Economic Loss would be caused by the Introduction of Sirex

The Committee's observations in New Zealand lead it to the opinion that in certain circumstances *Sirex* is a very severe economic pest. In a previous section of this report reference is made to an extreme case of an area where through *Sirex* infestation the volume of timber was reduced by more than three-fourths in a period of two years. It is obvious that the financial return from the expenditure on capital value of the land and planting and caring for the trees would be similarly reduced.

In addition the presence of *Sirex* necessitates the expenditure of money and time on control measures. The introduction and liberation of parasites, the maintenance of research institutes, the salaries of research officers and the cost of inspecting logs and timber to see that they are free of *Sirex* before sale are substantial items of cost which

(1) U.S. Dept. Agric. Bull., 343, 1916.
(2) U.S. Dept. Agric. Bull., 1298, 1925.
(3) Bull. Royal School of Forestry, Stockholm, No. 4, 1949.

could be avoided if *Sirex* could be kept out of the forests. In New Zealand it was agreed that "safeguards against *Sirex* cost money", and that "every extra job that has to be done adds to the cost of the product."

6. Australian Conditions are Favourable to the Spread of Sirex

Reference to Appendix V will show differences of opinion among European authorities on the question of whether *Sirex* attacks only sick trees. The consensus of opinion, however, appears to be that the trees most susceptible to *Sirex* infestation are those suffering decrease in vigour through unsuitable soil conditions, drought, damage through fires, storms, snow, squirrels or other causes, or becoming over-mature; newly-felled trees are also susceptible. One French authority says: "Trees are susceptible to attack whatever may be their age and state of health; nevertheless dying trees are more susceptible." From its inquiries in New Zealand the Committee has arrived at the conclusion that the trees most likely to be attacked are those which have for some physiological reason recently suffered a setback; these trees include those which had hitherto been growing vigorously.

It is true that *Sirex* has not reached epidemic proportions in Europe and North America, where it has been long established. This may be largely due to the conditions of the forests in relation to the climates and soils of these areas; its natural enemies, no doubt, exercise some control. It is noteworthy that in New Zealand it has severely attacked a species of *Pinus,* viz. *P. radiata,* which is not grown extensively in those countries. In this it may be likened to other flora and fauna which cause little trouble in their natural habitat, but become severe pests when introduced into another country where climate, food and other aspects of the environment are different, and where natural enemies are not present. Instances of this are prickly pear, rabbits, sparrows and deer. In the realm of forestry the snout beetle (the snout beetle that has been introduced into South Africa), the scolytid beetle (*Ips*), the gypsy moth and the smaller European elm-bark beetle may be quoted as examples.

Experience in other countries has shown that *Sirex* eggs laid in healthy trees have little chance of maturing, but that in times of drought the *Sirex* larvae may be hatched and continue their life cycle. In all the areas in Australia (except those in Queensland) in which there are pine plantations, periods in summer in which there is little or no rainfall are a regular feature of the climate and provide favourable conditions for *Sirex* to develop; in Queensland, where the normal dry period is late winter and spring, summer droughts occur from time to time.

Apart from drought there are other causes of sickness in many of the Australian plantations, the most notable being soil deficiencies. In Western Australia, for example, pines are grown with the aid of inorganic fertilizers, in some instances on very poor soils unsuitable for the growth of other crops. Even in the regions of excellent pine growth, such as the Mount Gambier district in South Australia, there are occasional areas showing unsatisfactory development apparently through soil deficiency or drainage defect.

In Australia forests are liable to fierce fire ravage, and losses are suffered even in pine plantations. Wood wasps are prone to attack fire-damaged trees, and an attack on plantations such as those swept by fire early in 1952 in New South Wales and the Australian Capital Territory may enable the wasp to reach epidemic proportions.

The Australian pine plantations consist for the most part of *Pinus radiata,* a species which in New Zealand has proved to be subject to ready infestation by *Sirex noctilio.* What has happened in New Zealand could happen in Australia but on a much greater scale by reason of the drier climate, greater liability to forest fires and sporadic occurrence of unsatisfactory growth.

7. Quarantine Precautions should be Intensified

The many problems confronting the quarantine of timber on our wharves or nearby in a period of unprecedented import activity are both intricate and difficult. Nevertheless, having regard to the grave threat to Australia's economy through failure to keep out an insect with such dangerous possibilities as *Sirex,* it is unthinkable that all possible quarantine precautions should not be taken.

Timber is a commodity of great bulk, and the Committee is aware of the difficulties presented by ship delays, and added costs caused by handling for fumigation or heat treatment when single shipments may amount to about three millon super. feet.

However, the possibility that fumigation or heat treatment may be necessary must be faced by persons importing any timber into Australia, and some knowledge of the origin of the timber and the pests occurring in the countries in which it is grown would provide some indication for the purchaser of what may be expected on arrival in Australia.

The present quarantine restrictions against *Sirex* have already been set out in a previous section of this report. The Committee is of opinion that there is urgent need for the intensification of quarantine procedure. The energetic action taken at certain ports during April-May, 1951, was thoroughly justified and is to be commended. On the other hand, unnecessary risks of the introduction of *Sirex* to Australian plantations have, to the Committee's knowledge, been taken in various States on a number of occasions. One cause of this want of firm action is, the Committee believes, a tendency for the Division of Plant Quarantine to give State Quarantine Officers (Plants) too much discretion, which has resulted in variations in thoroughness of precautions in the different States.

All instructions to Chief Quarantine Officers (Plants) should be in writing, and any verbal alterations to the instructions should be confirmed in writing. This would greatly strengthen the position of these officers.

In most States the number of officers employed on the inspection of timber imports is very inadequate; the Chief Quarantine Officer (Plants) in one State estimated that, because of shortage of staff as well as other reasons, his inspectors see only two per cent. of the surface area of timber imported at his main port. In another State it was stated that at times inspection of imported timber suffered because the officers employed are State officers who have many other important duties to attend to, such as the inspection of fruit for export.

Particulars of the amounts reimbursed to the States on account of quarantine work have been furnished to the Committee. In the case of certain States the amount is so small as to indicate either that very little inspection work is being performed or, alternatively, that the State is failing to claim on the Commonwealth for full reimbursement of the cost of the services rendered.

In some States, and also in New Zealand, the quarantine officers can call on the Forest authority for assistance in inspecting imported timber. Competent officers with a knowledge of timber are thus available, when required, to help at the wharves. The Committee gathered that in at least one State such help is not being made available. It is in the interests of the Forest authority to keep timber pests out of the country, and therefore any necessary help should be given willingly. The matter should, however, be arranged officially by the Commonwealth Department of Health, and payment made if necessary.

In the following instances which have come under its notice the Committee considers that undue risk of the introduction of *Sirex* into Australian plantations has been taken through insufficiency of quarantine precautions:

(a) A shipment of prefabricated buildings was found to be infested with *Sirex.* The exterior of the crates as stacked at the wharf was sprayed with 4 per cent. D.D.T., and the crates were then

allowed to be transported by road over 100 miles to the site at which they were to be erected. When the crates were opened, only about 25 per cent. of the timber was found to be unaffected—the remainder showed flight holes and other evidence of *Sirex*. A number of wasps was found, including one actually emerging from the timber. The only treatment given was a spraying with a 5 per cent. solution of pentachlorphenol in turpentine.

(b) A shipment of prefabricated houses found to be infested with *Sirex* was left on the wharf for about a week without any spraying prior to removal for fumigation. During this period at least two live wasps were found to have emerged.

(c) A large shipment of prefabricated houses, owned by a public body, and found to be infested with *Sirex,* has been brought ashore and placed on sites which are not quarantine areas, and from which the insect could escape to nearby pine trees. After two months the timber was still awaiting treatment by heat or fumigation, and meanwhile live wasps were being discovered.

(d) During the last year or so softwood timber has been imported to an extent greater than Australia's requirements, with the result that large stocks are being held by timber merchants. In view of the circumstances that inspection at the wharves cannot be thorough, and that the life cycle of *Sirex* may be three years, further periodic inspections of imported timber held by merchants are desirable, but owing to lack of staff are not being made.

Because of a shortage of suitable kilns in which to treat timber, quarantine officers have, on occasions, allowed *Sirex*-infested timber to be delivered to timber merchants on their undertaking to have the timber treated within a certain time. In the opinion of the Committee the Department of Health should install at all main ports its own plant for the treatment of timber. While heat treatment with steam has had to be relied upon in the past to destroy insects in timber, it has recently been shown that closely stacked timber can be successfully fumigated with methyl bromide. At the inquiry interesting evidence was given of tests made by the Division of Wood Technology of the Forest Commission of New South Wales with methyl bromide fumigation. Quarantine officers are examining the possibility of fumigating timber in the ship's hold.

It would appear that fumigation with methyl bromide, as a method of killing insects in timber, will become more popular than heat treatment. It has been shown that suitable air-tight rooms of plywood, wall board or other timber, lined with tarred and reinforced kraft paper, and capable of retaining methyl bromide can be erected at comparatively low cost. Airtight tents made from polyvinyl chloride sheeting or other materials can also be used for fumigation, and can be easily moved from place to place.

If heat treatment chambers or fumigation rooms and tents were installed at all ports, heat treatment or fumigation of all infested timber and prefabricated houses could be carried out expeditiously and without incurring the expense of double cartage. This assumes that at each port sufficient supplies of necessary materials would be available.

Research is still necessary concerning the most effective and inexpensive means of treating timber infested with any pest, and it would be of advantage if the Department of Health were provided with a sum of money to enable this research to be carried out.

8. Procedure Recommended

Until research shows some other effective means of treating *Sirex*-infested timber, the Committee considers the following action should be taken in regard to imported softwood timber:

Inspection of Vessels. The Committee's inquiries indicate that the inspection and treatment of vessels is not always as thorough as is necessary. Quarantine officers should inspect every vessel carrying timber immediately on its arrival in port, and thereafter frequently while it is unloading. In the event of any wasps or any other sign of infestation being found, the holds should be treated with Gammexane or other suitable insecticide. Any infested timber, crates, etc., stacked on the wharf awaiting removal for treatment should be sprayed throughly once a week with 2 per cent. D.D.T. or some other suitable insecticide.

Timber. It appears to the Committee that far too much risk has been taken on many occasions in allowing timber showing signs of *Sirex* infestation to be delivered to timber merchants subject to treatment at some far distant date. The reason for this has been the shortage of equipment to treat the timber. The Department of Health should make it an urgent matter to obtain sufficient equipment of the types referred to in a previous paragraph to enable it to give reasonable expedition to the treatment of all normal shipments.

Infested Prefabricated Houses. Probably the greatest risk of *Sirex* becoming established in Australia has been through the importation of infested prefabricated houses which have mostly been the property of Commonwealth and State instrumentalities, although houses have been imported as personal property of individual immigrants. It is very unsatisfactory to have these houses distributed throughout the State, or even stored in a central depot, with no treatment beyond a surface spraying of the crates with a D.D.T. solution. Speedy treatment in a kiln or with methyl bromide is the only safe course known. Unless the Department of Health can have installed equipment which will make it practicable to carry out a speedy fumigation of the largest consignment of prefabricated houses likely to be imported, the Committee is of opinion that the importation of prefabricated houses should be restricted to those which contain only kiln-dried timber or timber which has been disinfected by some other method approved by the Department of Health. The Committee has learned of two instances in which prefabricated houses were imported with an accompanying certificate that the timber had been heat treated.

In one State the Commonwealth Department of Works and Housing imported a shipment of prefabricated houses which were found to be infested with longicorn beetles. These were effectively treated with methyl bromide in an airtight chamber specially constructed for the purpose. The chamber has since been used for fumigating material infested with *Sirex*.

Cases and Crates. Inspection of visible surfaces of cases and crates stacked on wharves is the only method of detection practicable, but at some ports the amount of inspection needs to be considerably increased. It must be realized that there is always a likelihood of inferior timber being used for making packing cases and crates. Infestation has been reported recently in cases and crates from the United Kingdom, Continental Europe, the United States of America and Japan. The methods laid down by the Director of Plant Quarantine for dealing with cases and crates found to be infested with *Sirex* are considered by the Committee to be reasonable.

Dunnage. Particular care is necessary in respect of dunnage, which is usually the lowest grade of timber, and it should invariably be closely inspected before being released.

Specific instructions along these lines should be issued to all Chief Quarantine Officers (Plants).

It is of interest to note that in New Zealand all timber, prefabricated houses, packing cases and crates are inspected

on importation, and in the event of any *Sirex* being found the particular pieces of timber or the packing cases or crates have to be destroyed by fire, notwithstanding that *Sirex* is already present in that country.

To sum up, quarantine precautions against the entry into Australia of *Sirex* should be intensified, and this requires more thorough inspection, more staff, more funds and more equipment.

9. Government Certificates from Exporting Country are Desirable

The Committee is of opinion that the likelihood of *Sirex*-infested timber being imported would be greatly lessened if importers were required to provide certificates from a Governmental authority in the exporting country certifying that the timber was milled from living healthy trees, and so far as is known is not infested by *Sirex*. The Committee has received indications that New Zealand and Roumania would be prepared to give such certificates, and it is likely that any other timber-exporting country which wished to sell timber to Australia would also do so.

Such a certificate would not of course remove the necessity for inspection, but timber arriving without a certificate would be subject to more intensive inspection. This intensive inspection would also apply to timber arriving with a certificate which previous experience had shown to be untrustworthy.

During its visit to New Zealand the Committee paid special attention to the precautions taken to prevent the exportation of timber infested or likely to be infested with *Sirex*. It formed the opinion that the steps already being taken were such that the furnishing of a Government certificate in respect of exported timber would necessitate no inspection of the timber other than that already being carried out. However, while the Committee was in New Zealand it received advice that a shipment of sawn timber from one of the largest New Zealand suppliers had arrived in Australia showing definite *Sirex* infestation. This clearly shows that Government certificates can never replace quarantine inspection, and can only be regarded as being complementary to it.

New Zealand exporters of timber are required to brand each board in such a way as to indicate the supplier and the grade. If timber from other countries imported into Australia bore definite evidence of the supplying mill it might render the use of the proposed certificates more effective.

A more desirable certificate of course would be one that the timber had been heat-treated or disinfested by some other method approved by the Department of Health.

Concerning packing cases and crates it would be reasonable to require exporters to certify, on their invoices or separately, that the timber used shows no signs of infestation by *Sirex* or other timber pest and has no bark adhering to it. During its inspections of the wharves the Committee has often seen cases in which the timber used was heavily covered with bark. The Department of Health should, by publicity or any other measures, encourage importers to impress on exporters the necessity for using timber free from bark for the manufacture of cases.

10. Quarantine Precautions are not Costly

Representatives of timber importers stressed, in their evidence, the great cost of the present quarantine precautions. It should be emphasized, however, that the necessity for treatment, and therefore the cost, applies to only a small portion of the timber imported. It is very difficult to determine accurately what portion of imported timber must be treated. Mr. Bilbe, Senior Quarantine Inspector, Sydney, gave evidence that the S.S. *Marilen,* which arrived early in 1951, discharged 2,710,572 super. feet in Sydney, and that, of this quantity, about 250,000 super. feet had to be heat-treated. In subsequent shipments the percentage of timber heat-treated was considerably smaller. It would appear therefore that the proportion of total imports that had to be heat-treated was not more than 10 per cent. and, in fact, was possibly considerably less. However, taking a figure of 10 per cent. would mean that in 1950-51 the total quantity of timber treated was about 35,214,000 super. feet. In Melbourne the cost of treatment was given as 8/6 per 100 super. feet; in Sydney it was given as being 10/- to 15/- per 100 super. feet. Taking an average of 11/- the total cost of treatment would be about £194,000. The f.o.b. value in Australian currency of softwoods imported during 1950-51 was £17,532,584. The cost of heat treatment for quarantine purposes would thus be little more than 1 per. cent. of the value of the timber imported.

The proportion of imported timber found to be infested in April-May, 1951 was much greater than it had ever been before and greater than it has been since. Before 1951 Baltic timber had been remarkably free of such pests as *Sirex*. Evidence was given that, in 1925, the Timber Importers' Association and the Sydney Timber Merchants' Association had certified that no member of either association had ever found borer or any kind of insect in Baltic timber. There is no doubt that the quarantine action taken early in 1951 has had the effect of making importers and exporters more careful to avoid the shipment of *Sirex*-infested timber. Moreover, with a return to a buyer's market—and there is evidence of such a return—it is to be expected that less inferior timber will be sent to Australia.

For these reasons the Committee believes that the proportion of timber that has to be treated will continue to diminish, and that this part of the cost of quarantine will also diminish.

11. Quarantine Fees should be Waived on Timber Suitably Treated before Shipment

Some encouragement to the treatment of timber before shipment to Australia would be given by an increase in the quarantine inspection fees on timber generally and the waiving of the collection of fees on imported timber and timber products covered by a certificate, from a Governmental authority or other acceptable source, that the timber had been treated before shipment in a manner acceptable to the Australian quarantine authorities. Another condition of the waiving of fees should be that each board or package is so marked as to be readily identifiable. This action might encourage the installation of kilns by exporters in New Zealand, a country which is expected to supply a large and increasing portion of Australia's future softwood requirements.

12. Publicity can help

It is impossible for quarantine officers to inspect every piece of timber or every packing case or crate imported, but they could and would be aided greatly in the fight against *Sirex* by waterside workers, harbour trust delivery clerks, carters, sawmill and timber yard employees and others if an attractive illustrated poster were prepared and displayed in suitable locations. This poster could deal with other pests as well as *Sirex* (for example the bark beetle), and could emphasize our forest wealth and the damage which imported pests could do to it.

The importance of the awakening of public consciousness to the fact that *Sirex* and other insects do represent a menace to our forest assets and the well-being of the community must be stressed. Any means of reaching the public through brochures, posters, films, broadcast sessions, newspaper articles and essays in schools would be helpful.

13. Strong Quarantine Action should be taken to Prevent the Spread of Sirex wherever It may become Established in Australia

In March, 1952, *Sirex noctilio* was discovered breeding in a small private plantation of *Pinus radiata* at Pittwater near Hobart, Tasmania. So far as is known this is the only record of any species of wood wasp established in Australia. It is noteworthy that the species at Pittwater is *Sirex noctilio,* the same as in New Zealand. Although this species is known to occur in Europe and the United States, it is a relatively rare species in those countries, and it has not so far been intercepted in quarantine in timber and crates from the Northern Hemisphere. The species most commonly intercepted from these countries are *Urocerus gigas* and *Sirex juvencus*. On the other hand *Sirex noctilio* has been found at least twice in timber imported from New Zealand.

The Committee wishes to emphasize that Australia appears to be in even more danger from *Sirex noctilio,* which is established in New Zealand and Tasmania, than from other species, because *S. noctilio* is a species which

(a) in Europe prefers pines to other trees;
(b) prefers small trees; and
(c) has become adapted to *P. radiata* in the Southern Hemisphere.

It seems likely that the infestation in Tasmania originated from New Zealand. There are three suggestions regarding the source of this infestation:

(a) Pine logs shipped from New Zealand in 1946 to Australian Newsprint Mills Ltd., Boyer, Tasmania.
(b) Packing cases made from New Zealand timber imported into Sydney and used for crating machinery for the new aerodrome near Pittwater.
(c) Timber from packing cases and other low-grade timber which has been used in the construction of week-end cottages along the beaches near the Pittwater plantation.

Circumstances suggest that *Sirex* may have been in Tasmania for several years.

A very careful watch is being kept on the Pittwater plantation by the Tasmanian Forestry Commission. There is no indication that the wood wasps are numerous, and an attempt has been made to deplete their numbers by destroying all the trees in the fire-damaged patch where they were known to be breeding, and any other tree that shows any sign of their presence. In view of the great difficulty of finding the immature stages inside the living tree these precautions are hardly likely to do more than impose a check on the wood wasps.

The Committee therefore urges that, during the next two summers at least, a thorough search be made at Pittwater and elsewhere in the vicinity. If any signs of *Sirex* are found a quarantine regulation should be issued requiring that the timber milled from that area should be treated either by heat or by methyl bromide before it enters into commerce either in Tasmania or in any other State. Not only should the movement of timber out of the area be restricted, but other measures likely to be effective should be taken, e.g. the cutting-out of areas known to be infested or the removal of trees to form a buffer around the area known to be infested.

Similar action should be taken if *Sirex* should become established in any other plantation in Australia. Every endeavour should, in the Committee's opinion, be made to localize any outbreak of *Sirex* that might occur anywhere in Australia.

In view of the volume of timber imported into Australia during the last few years it is important that all foresters and others connected with plantations should maintain a keen watch for any indications of *Sirex* during the next two summers at least. It is hoped that suitable literature on the insects and their habits will be made available through the Division of Plant Quarantine.

14. There is a Need for Fundamental Forestry Research

The Committee considers that the Commonwealth Forestry and Timber Bureau should be encouraged to proceed immediately with a vigorous research programme into fundamental factors underlying the growth of exotic trees in Australia, and that it should be provided with the necessary staff and finance to enable it to do so. The Committee considers that such work would not be a widening of the Bureau's functions beyond those which were originally intended; it would merely be the putting into effect of measures proposed and foreseen as necessary when the Bureau was established. Attempts by States to carry out such work individually would, to a great extent, be an unnecessary duplication of effort.

It is believed that research of this nature would result in the removal of factors which might make Australian forests and plantations suitable for the establishment of *Sirex* and other pests. On the other hand, if such pests should become established the basic information, which would lead to the eradication of the pest, may have been discovered as a result of research work.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

The Committee's conclusions which have been given in full in the preceding section are summarized as follows:

(1) Plantations of pine and other softwoods, as well as natural forests of softwoods, represent such a great and increasingly valuable asset in Australia that every effort should be made to preserve them against the damage which might follow the introduction of a serious pest or disease. (Conclusions 1 and 2.)

(2) The Siricid wood wasps are to be regarded as potentially serious noxious pests which should be kept out of Australia, if possible, because
   (a) They attack the living tree and may, in certain circumstances, cause widespread damage to forests of pines and other softwoods. (Conclusion 3.)
   (b) They may reduce the quality of the timber, pulp, and other products from the forests. (Conclusion 4.)
   (c) For these reasons, and because control measures may be costly, considerable financial loss to Australia might be expected to follow the establishment of this pest in any extensive area of softwood forest in this country. (Conclusion 5.)
   (d) After a thorough examination of the circumstances in which Siricid wood wasps exist and flourish in other parts of the world, the Committee fears that the climate in Australia and the condition of the Australian plantations would be favourable to their multiplication and spread. (Conclusion 6.)

(3) A sound and thorough system of quarantine measures is essential. (Conclusion 7.) The Committee is satisfied that in the past the operation of quarantine has greatly reduced the chance that this pest would become established in Australia. But the Committee is of the opinion that more risks have been taken than are desirable, and wishes to call attention to certain ways in which

the operation of quarantine measures might be improved:

(a) The detailed procedure which the Committee suggests is appropriate in dealing with cargoes which are found to be infested or might be infested with Siricid wood wasps is set out in section XII (8) of this report.

(b) More definite instructions to Chief Quarantine Officers (Plants) in each State would be a great advantage. (Conclusion 7.)

(c) The Health Department should have available, in each major port, its own equipment and materials for fumigating or otherwise treating promptly the largest amount of material likely to arrive at any one time. The objective should be to treat material at a rate as fast as it is unloaded so that it should never be allowed to accumulate on the wharves or in quarantine reception areas. (Conclusion 7.)

(d) Unless, or until this objective is achieved, the importation of prefabricated houses should be discontinued except where all the timber has been kiln-dried or otherwise suitably disinfested in the country of origin. (Conclusion 8.)

(e) Government certificates covering imported timber should be required from exporting countries. When possible, these certificates should specify that the timber has been subjected to heat or some other treatment acceptable to the quarantine authorities. Otherwise the certificates should state that the timber was milled from living healthy trees, and, so far as is known, is not infested with *Sirex*. (Conclusion 9.)

(f) Quarantine fees should be waived on timber that has been suitably treated before shipment. Quarantine fees on all other timber could be increased. (Conclusion 11.)

(g) Every effort should be made to discourage the importation of goods in crates and packing cases made from wood containing bark and otherwise likely to be infested with Siricid wood wasps and other pests. No timber carrying bark should be allowed into Australia. (Conclusion 2.)

(h) The staff of full-time inspectors should be increased, and arrangements should be made at an official level (where they do not already exist) whereby temporary staff may be borrowed, in an emergency, from Forest Departments and other suitable sources. (Conclusion 7.)

(i) Adequate staff and funds should be made available so that the Director of Plant Quarantine may conduct research into the most suitable and effective methods of dealing with the technical problems that arise. (Conclusion 7.)

(j) An active publicity campaign to enlist the help of the public is desirable. (Conclusion 12.)

(4) Since *Sirex noctilio* is known to be adapted to *Pinus radiata* and is the only species that has so far become established in the Southern Hemisphere, special care should be taken with cargoes from New Zealand and from Pittwater, Tasmania, where this species occurs. (Conclusion 13.)

(5) Strong action should be taken to prevent the spread of *Sirex* wherever it may become established in Australia:

(a) By restricting the movement of infested timber out of the area.

(b) By any other measures deemed likely to be effective in particular circumstances, e.g. the cutting-out of areas known to be infested or the removal of trees to form a buffer around the area known to be infested. (Conclusion 13.)

(6) Notwithstanding all the precautions which may be taken, there is still a possibility that *Sirex* will eventually become established in important forest areas on the mainland of Australia. Orthodox control measures by means of insecticides or introduced parasites are not likely to be practicable or effective. The best precaution is an immediate and active programme of fundamental research by the Commonwealth Forestry and Timber Bureau into the physiology and ecology of pine trees grown in the Australian environment. (Conclusion 14.)

In view of the conclusions set out above the Committee recommends that quarantine precautions against the entry of Siricid wood wasps into Australia be intensified.

(Sgd.) J. B. CUMMING,
Chairman.

(Sgd.) H. G. ANDREWARTHA,
Member.

(Sgd.) T. N. STOATE,
Member.

(Sgd.) K. P. LYNCH, Secretary.

Melbourne,
27th June, 1952.

APPENDIX I

LIST OF WITNESSES WHO TENDERED EVIDENCE AT THE PUBLIC INQUIRY

Technical Evidence

On behalf of Entomology Divisions, State Departments of Agriculture:

Stuart Leo Allman, Senior Entomologist,
Department of Agriculture, Farrer Place, Sydney.

Leonard William Miller, Chief Entomologist,
Department of Agriculture, Murray Street, Hobart.

Alfred Roy Brimblecombe, Entomologist,
Science Branch, Department of Agriculture and Stock,
William Street, Brisbane.

On behalf of Division of Plant Quarantine:

Travers Henry John Harrison, Director of Plant Quarantine,
Department of Health, Canberra.

Leslie Thomas Bilbe, Senior Inspector,
Plant Quarantine Service, Department of Agriculture,
Farrer Place, Sydney.

Frank Morris Read, Chief Quarantine Officer (Plants),
Victoria, Department of Agriculture,
Treasury Gardens, Melbourne.

Reginald George Morriss, Senior Quarantine Inspection Officer for Victoria, Department of Agriculture,
Treasury Gardens, Melbourne.

Harley Robert Powell, Chief Quarantine Officer (Plants),
Western Australia, Department of Agriculture,
St. George's Terrace, Perth.

Arthur Geoffrey Strickland, Chief Quarantine Officer (Plants), South Australia,
Flinders Street, Adelaide.

Everard Frederick Fricke, Chief Quarantine Officer (Plants), Tasmania,
Department of Agriculture, Murray Street, Hobart.

Robert Aiden Scott, Quarantine Inspector,
Department of Agriculture, Murray Street, Hobart.

Norman Royle Thompson, Port Inspector and Quarantine Officer (Plants),
Department of Agriculture, Launceston, Tasmania.

Stanley Alan Trout, Chief Quarantine Officer (Plants), Queensland,
Department of Agriculture and Stock, William Street, Brisbane.

On behalf of Government Forestry Authorities:

Geoffry James Rodger, Director General,
Commonwealth Forestry and Timber Bureau,
305 Collins Street, Melbourne.

William Douglas Muir, Officer in Charge,
Division of Forest Management, Forestry Commission of New South Wales,
Margaret Street, Sydney.

Philip Walter Hadlington, Research Officer,
Entomology Section, Division of Wood Technology, Forestry Commission of New South Wales,
Margaret Street, Sydney

Desmond Townsell Hartigan, Forest Pathologist,
Division of Wood Technology, Forestry Commission of New South Wales,
Margaret Street, Sydney

Matthew James McMullen, Research Officer,
Division of Wood Technology, Forestry Commission of New South Wales,
Margaret Street, Sydney

Finton George Gerraty, Chairman,
Forests Commission of Victoria,
Treasury Gardens, Melbourne.

Alfred Oscar Lawrence, Commissioner,
Forests Commission of Victoria,
Treasury Gardens, Melbourne.

Donald William Russell Stewart, Regional Forest Officer,
Forests Department, Perth.

Brian Herbert Bednall, Conservator of Forests,
Woods and Forests Department,
Gawler Place, Adelaide.

Alexander Hubert Crane, Chief Commissioner,
Forestry Commission,
Murray Street, Hobart.

Stanley Gray Jennings, Officer in Charge,
Forests Products Research Branch, Forestry Department,
George Street, Brisbane.

Other Evidence in favour of Intensification or Maintenance of Existing Precautions

On behalf of Forestry Organizations other than Government Forestry Authorities:

Leslie McBain, representing Ballarat Water Commissioners,
Ballarat, Victoria.

John Dougan Brookes, General Manager,
A.P.M. Forests Pty. Ltd.,
Aikman Street, South Melbourne.

On behalf of Australian Sawmillers and Timber Merchants:

Francis Frederick Kraegen, Manager,
Associated Country Sawmillers of New South Wales,
44 Margaret Street, Sydney.

Athol Albert Swallow, representing Local Timbers Ltd., Myrtleford, Victoria, and Bright Pine Mills Pty. Ltd.,
Bright, Victoria.

John William Youl, Manager,
Victorian Sawmillers' Association,
312 Flinders Street, Melbourne.

Colin Rex Mather, Secretary,
Tasmanian Timber Association,
54 Brisbane Street, Launceston, Tasmania.

Walter Ross Gilbert, Manager,
Queensland Timber Stabilization Board,
129 Creek Street, Brisbane.

Other Evidence in favour of Intensification

James Charles Banfield, Manager,
City Case and Box Factory,
30 John Street, West Perth.

Noel Harry Hearn, representing Hearn's Industries Ltd.,
Albany Road, Victoria Park, Western Australia.

Kenneth Stevenson, Timber Manager,
Bryant & May Pty. Ltd.,
560 Church Street, Richmond, Victoria.

In favour of Relaxation of Existing Precautions

On behalf of Timber Importers:

Frederick Maclean Hewitt, Assistant Secretary,
Sydney and Suburban Timber Merchants' Association Ltd., 19-23 Bligh Street, Sydney, and also on behalf of Newcastle Timber Merchants' Association.

Charles Edward Lane-Poole, on behalf of the Sydney and Suburban Timber Merchants' Association Ltd., 19-23 Bligh Street, Sydney.

Frederick Richard O'Connell, Manager,
Timber Merchants' Association of Melbourne and Suburbs,
51 William Street, Melbourne.

Lewis Edward Henry Baigent, Sawmiller and Timber Exporter,
Nelson, New Zealand.

Other Evidence in favour of Relaxation

George Joseph Collopy, Secretary,
Australian Lumber Co. Pty. Ltd.,
166 Roe Street, Perth.

Morris Pollock, Secretary,
Importers Section, Melbourne Chamber of Commerce,
35 William Street, Melbourne.

GENERAL EVIDENCE

Queeneth Samblebe, representing the Royal Swedish Consulate,
410 Lonsdale Street, Melbourne.

John Henry Hillston, representing J. H. Hillson & Co.,
283 Elizabeth Street, Sydney,
Australian representatives for State Company for Foreign Trade, Roumania.

APPENDIX II

SUMMARY OF EVIDENCE SUBMITTED AT PUBLIC INQUIRY

TECHNICAL EVIDENCE

On behalf of Entomology Divisions, State Departments of Agriculture:

By S. L. ALLMAN

(1) It appears certain that Siricid wood wasps have not yet become established on the Australian mainland. Wasps have been intercepted on occasions for many years, but it is only recently that they have been found in such large numbers.

(2) Information is given relating to recent shipments of infested timber and the treatment at present prescribed by the quarantine authorities.

(3) Plant quarantine has been considered by the Food and Agriculture Organization of the United Nations. The relevent sections of a proposed agreement on this matter are quoted.

(4) Following the discovery of *Sirex* in timber imported into Australia from New Zealand in 1949, representatives of the timber industry and the New Zealand Forest Service agreed that certain steps should be taken to prevent *Sirex*-infested timber being exported from New Zealand.

(5) If possible, timber should be heat-treated in the exporting country. However, because of the intense competition for available supplies of timber, it is possible that the imposition of restrictions would cause overseas suppliers to sell their timber elsewhere.

(6) Deliberate introduction of new insect pests, even of minor importance, would not be countenanced by any entomological authority. Instances are quoted of relatively unimportant forest insects causing serious damage in a new environment.

By L. W. MILLER

(1) Evidence is given regarding interceptions of *Sirex* wasps in timber and timber products imported into Tasmania. Within the experience of the witness *Sirex* wasps have been submitted for identification only within the past twelve months.

(2) Some of these wasps were discovered after the material in which they were found had been passed by quarantine officers. There have probably been other introductions which have completely escaped detection, and it is believed that present quarantine regulations do not give adequate protection against the introduction of living *Sirex* wasps into Tasmania.

(3) It is considered that the successful establishment of *Sirex* in Tasmania depends more on whether the environment is suitable to the insect rather than on whether quarantine precautions are satisfactory. The Tasmanian environment is closer to that of New Zealand and England than is that of most mainland States.

(4) A description is given of the outbreak and possible origin of *Sirex* infestation in Tasmania. The possibilities of its eradication are also discussed.

(5) The Government of Tasmania considers that the fact that an outbreak of *Sirex* has been recorded in Tasmania should not result in discriminatory action being taken against Tasmania's interstate trade in pine timber. The Government is prepared for Tasmanian timber to be subjected to inspections similar to those made of overseas timber, but considers that the imposition of special restrictive conditions would be unjust.

By A. R. BRIMBLECOMBE

(1) Details are given regarding the interception of *Sirex* material in timber and timber products imported through Queensland ports. Detection of *Sirex* has in most cases been due to adult emergence. coinciding with the arrival of the timber in Australia. Detection is impracticable in timber from logs converted shortly after infestation and which has arrived in Australia before adult emergence.

(2) The first recorded interception in Queensland was a Siricid wood wasp found in 1910 in the wooden core of a roll of cloth.

(3) Queensland's plantations of exotic conifers contain species susceptible to *Sirex* attack. Serious attack by *Sirex* is erratic. No action against an attack may appear warranted unless an epidemic occurs, and then any action is futile. Biological control is the most feasible method for dealing with an insect pest in mountainous terrain. Such control in New Zealand, however, did not prevent *Sirex* reaching epidemic proportions.

(4) Conditions in Queensland are considered to be suitable for the spread of *Sirex*.

(5) Queensland has no surplus trees in its plantations, and losses through *Sirex* would be much more serious than they were in New Zealand.

(6) Quarantine precautions against *Sirex* should be intensified. Timber should be sterilized by heat or other means in the country of origin, and only clean timber should be acceptable to Australia.

On behalf of Division of Plant Quarantine:

By DR. T. H. J. HARRISON

(1) A brief history of plant quarantine is submitted together with a statement of the arrangements made between the Commonwealth and the States in regard to quarantine matters.

(2) The action taken by the quarantine authorities in 1951 has resulted in a very definite improvement in the quality of the timber since exported to Australia. Information is given regarding representations made to various Governments and authorities in an attempt to reduce the risk of *Sirex* being imported into Australia.

(3) With the exception of Victoria heat-treatment facilities available in the various States are totally inadequate, and the Department is pursuing the possibility of erecting its own heat-treatment and fumigation facilities with which to meet any similar emergency.

(4) An importer in Victoria has erected a fumigation chamber with a capacity of 150,000 super. feet of timber.

(5) The original list of pests to be excluded from Australia was drawn up in 1907-8, and Siricid wood wasps were included in that list. Evidence held by the Department suggests that at least up to 1925 *Sirex* had not been seen in timber imported into Australia.

(6) The Department has evidence to show that increases in freight rates in 1951 were not due to quarantine precautions but to a combination of other factors such as slow turn-round in Australia, the long voyage to Australia, competition for chartered tonnage to meet demands for the Korean war, Britain's export drive, etc.

(7) A description is given of the action taken by the

quarantine authorities in regard to the outbreak of *Sirex* at Pittwater, Tasmania. It is hoped that this action will result in the eradication of *Sirex* from this area.

By L. T. BILBE

(1) Evidence is submitted regarding the method of handling timber and the way in which the quarantine regulations are administered in Sydney.

(2) Details are given of the circumstances in which *Sirex* was discovered in Sydney in 1951, and of action subsequently taken by the quarantine authorities. At that time Sydney wharves and timber yards were congested because of the large quantities of timber awaiting treatment for other insect pests. For this reason it was not possible to carry out quarantine measures as effectively as was customary.

(3) The following statements are submitted:

(a) List of vessels bringing European whitewood to Sydney during the period 15th February, 1951, to 7th November, 1951, and the results of inspection of the cargoes.

(b) Results of inspection at Sydney of ships reported in Melbourne as carrying infested cargo.

(c) Particulars of kiln capacity in Sydney.

By F. M. READ

(1) Evidence is given regarding action taken by quarantine authorities in Victoria following the interception of *Sirex* in timber and timber products imported early in 1951.

(2) Much of the delay that occurred in 1951 can be attributed wholly or almost wholly to the timber importers.

(3) The issue of certificates from the Government of countries exporting timber to Australia would be of considerable help even though inspection of the timber would still have to be made on arrival in Australia.

(4) *Sirex* has always been regarded as an important pest, and has been looked for in all timber which has been inspected in Melbourne. This has been the position for at least twenty-five years.

By R. G. MORRISS

(1) Reference is made to instances where *Sirex* has been intercepted by quarantine officers in importations in Victoria to show that present quarantine procedure has been carried out consistently for many years.

(2) Information is also given regarding quantities of timber heat-treated and the number of kilns used during the last few years.

By H. R. POWELL

(1) Evidence is given concerning quarantine precautions taken in Western Australia against *Sirex* wood wasp in sawn timber, prefabricated houses and crated general cargo. Evidence is also given regarding methods of inspection.

(2) At the date of the inquiry no *Sirex* has been found in imported sawn timber. *Sirex* has been discovered in prefabricated houses. No live insects have been found in cases and crates, although in some instances the timber in the crates has contained flight holes.

(3) Full safeguards do not appear to exist for preventing the introduction of *Sirex*. In regard to sawn timber and prefabricated houses, it is considered that certificates from exporting countries together with inspection services in Australia would minimize the risks of introduction. The inspection would have to be done with the co-operation of importers, Forest Services and other interests. Where possible crates and cases should be made from treated timber. It would help if some publicity were given to the problem of keeping the insect out of the country.

(4) There is no indication that *Sirex* has yet been introduced into Western Australia.

By A. G. STRICKLAND

(1) Evidence is given regarding quantities of timber and prefabricated houses imported into South Australia during 1950 and 1951. Information is also given regarding quarantine inspection procedure and treatment facilities available in that State.

(2) A statement is submitted showing *Sirex* interceptions arranged in chronological order with notes on action taken in each case.

(3) It is submitted that the soundest means of checking the introduction of *Sirex* into the country is to:

(a) Insist upon stringent inspection and certification in the country of origin of all imports of timber, including crates, where the type of timber is such that it is liable to *Sirex* attack and where *Sirex* is established in the country of origin.

(b) Maintain and increase, within the limits of practicability, quarantine inspection services during discharge of overseas timber in Australian ports.

By E. F. FRICKE

(1) Evidence is given regarding the experience of Tasmanian quarantine authorities with importations of timber and timber products during recent years. Evidence is also given regarding action taken by the quarantine authorities in connection with the outbreak of *Sirex* in Tasmania.

(2) A large increase in staff would be needed to inspect all crates at all times when ships are unloading. Special staff would also be necessary to turn cases over as required. Such increases could not be justified unless interior surfaces of the cases were also examined, and this would involve considerable difficulty.

(3) The quarantine authorities have insufficient equipment for treating large quantities of timber or crates. Plans have been prepared for a large fumigation chamber at Hobart.

By DR. R. A. SCOTT

Evidence is given regarding action taken by the quarantine authorities in connection with prefabricated houses found to be infested with *Sirex*. The houses which were imported from France were erected in Launceston.

By N. R. THOMPSON

(1) Evidence is given regarding the practical difficulties experienced by a quarantine officer in examining timber arriving in Tasmania from overseas countries.

(2) A complete list of all countries in which *Sirex* has been found would be helpful to all quarantine officers.

(3) Under present conditions it is virtually impossible to make a complete examination of all imported timber.

By. DR. S. A. TROUT

(1) Evidence is given regarding quarantine requirements in respect of imported timber. Information is also given regarding instances where *Sirex* has been found in timber and timber products imported through Queensland ports.

(2) A description is given of a fumigation chamber erected in Brisbane by the Commonwealth Department of Works and Housing for the fumigation of prefabricated houses which were found to be infested with longicorn beetles. This chamber has since been used for treating prefabricated

houses infested with *Sirex*.

(3) The following conclusions have been reached regarding the importation of timber likely to be infested with *Sirex*:—

(a) Inspection of individual pieces of sawn timber is painstaking and tedious, and involves delay.

(b) There can be no certainty that all infested boards have been detected.

(c) Unless carried out on the site of erection, it is impossible to inspect every piece of timber in prefabricated houses.

(d) If there is evidence of *Sirex* infestation the whole consignment should be treated. This would require transport of the cargo to an isolated centre.

(e) Fumigation by methyl bromide appears to be successful, but present facilities in Brisbane are not adequate.

(f) Treatment of cargoes after arrival does not preclude the possibilities of wasps emerging during discharge of cargo and during transport to the treatment centre.

(g) The best safeguard against the introduction of timber pests into Australia is to ensure that all consignments are effectively treated in the country of origin prior to export. Imports of timber would then be conditional on production of a certificate of treatment from a responsible authority in the country of origin.

On behalf of Government Forestry Authorities

By G. J. RODGER

(1) Statistics are submitted showing quantities of timber imported into Australia during 1949-50 and 1950-51, and Australian production of softwood timber during the same two years.

(2) Copies of statements on *Sirex* prepared by the Imperial Forestry Institute in the United Kingdom and the Forestry Division of the Food and Agriculture Division of the United Nations are also submitted.

(3) One of the functions of the Forestry and Timber Bureau is research into silviculture, forest protection and forest management. Little of this work is being done at present, however, largely because trained staff is not available. It would be a waste of knowledge and money for the various States to attempt to carry out this work.

(4) If such research work were being carried out the likelihood of a serious *Sirex* outbreak in Australian plantations would be lessened.

By W. D. MUIR

(1) Statements are submitted showing the area of existing *Pinus* plantations in New South Wales and the location of the principal *Pinus radiata* plantings in the Central and Southern sections of the State. Details of the value of the plantations are also given.

(2) Certain large areas of *Pinus radiata* planted before 1936 are of poor development and vigour, and are similar in condition to areas in New Zealand where severe *Sirex* infestaion has occurred.

(3) New South Wales plantations are subject to drought periods which, at least temporarily, impair their vigour to a serious extent. Moreover, if the demand for timber should fall it may not be possible to market thinnings with the result that the plantations could not be maintained in their present thinned and vigorous condition.

(4) Even though there is a marked difference between weather conditions in Europe and Australasia, *Sirex* became established in New Zealand. It is feared that the warm temperatures in New South Wales would increase the rate of spread of *Sirex* insects.

(5) The Forests Commission is worried about the establishment of *Sirex* in New South Wales plantations. Searches have been made, but there is as yet no sign that it has become established.

By P. W. HADLINGTON

(1) It is suggested that the term "*Sirex*" wood wasps in the Committee's reference should be replaced by the term Siricid wood wasps. This term would include wood wasps other than those belonging to the genus *Sirex* which have been recently intercepted in Australian ports.

(2) A description is given of the life cycle and general characteristics of the wood wasp together with some information relating to New Zealand's experience.

(3) A list is given of the wasps collected and recorded in Sydney. It is considered that the number of wasps which have escaped from ships' holds and timber stacks around Sydney would be much greater than the number collected.

(4) The immediate effect of the establishment of *Sirex* in New South Wales would be the attack on weakened and suppressed pine trees in plantations and natural stands. In time of drought many trees would be affected. In addition to the loss of timber there would in some areas be loss through erosion and secondary effects due to the removal of cover.

(5) Various plantations have been inspected, and all foresters and people in charge of sawmills have been instructed to watch for the insect. There is, however, no evidence that the wasp has as yet become established in any New South Wales plantation.

(6) In the event of *Sirex* becoming established in Australia control measures could take the form of control by chemicals, introduction of parasites, or by the carrying out of pruning and thinning operations. All of these measures, however, suffer from serious drawbacks.

By D. J. HARTIGAN

A description is given of the fungus associated symbiotically with *Sirex noctilio*.

By M. J. MCMULLEN

(1) Following a suggestion made by the Chief Entomologist of the Department of Agriculture, the Division of Wood Technology, Forestry Commission of New South Wales has carried out experiments on the efficiency of methyl bromide as a fumigant for timber. Details of the experiments are given.

(2) The experiments have shown that relatively low concentrations of methyl bromide will in twenty-four hours penetrate Baltic pine and hardwoods up to almost three inches in thickness, and that it will penetrate even large stacks of block-stacked timber. The sterilization of timber in ships' holds presents difficulties, but these are not insurmountable. It is estimated that the cost of fumigating timber in a ship's hold would be 1s. to 2s. per 100 super. feet. This would include such costs as demurrage charges.

(3) Ethylene dibromide is another fumigant which might be used for sterilizing timber.

By F. G. GERRATY

(1) Victoria, as well as the rest of Australia, is deficient in natural softwood timber resources. Imports cannot be relied upon to remedy this deficiency. The Forests Commission has for many years been engaged in the establishment and management

of exotic pine plantations, and planting will be progressively extended.

(2) Pine can be grown successfully on land which is of little value for pastoral and agricultural purposes and from which the production of hardwood timber has been small. Considerable tracts of such land are available in Victoria.

(3) Information is given regarding the extent and value of present and proposed exotic plantations in Victoria.

(4) No report has been received that *Sirex* has become established in Victorian plantations.

(5) All softwood timber imported should be treated to ensure that no *Sirex* or other harmful insects are imported into the country. It would be best if the treatment could be carried out in the country of origin.

By A. O. LAWRENCE

(1) Victorian softwood plantations are pure stands, and the Commission is concerned at the possibility of *Sirex* spreading among its plantations. Examples are given of damage done to forests by other insect and fungus pests.

(2) Information is submitted regarding the occurrence of *Sirex* in New Zealand and steps being taken in that country to combat it.

(3) Judging by New Zealand's experience, Victorian plantations are most susceptible to infestation by *Sirex*. Some stands in Victoria are overcrowded; some have dead and dying trees, and there are large areas of "sickly" trees. In addition Victoria experiences long, dry, hot summers.

(4) The Forests Commission strongly recommends that quarantine inspection of timber, timber products, plants and seeds arriving in Australian ports should be prosecuted in such a manner and through the medium of such Acts and Regulations as will ensure that no forest pathogen can gain entry into this country. The Commission also recommends that no sawn timber be allowed to enter port unless covered by a certificate that it had been heat-treated before shipment.

(5) All imported timber need not be treated. It may be practicable to divide any shipment of timber into various lines, and only that line showing infestation need be treated. If this action were taken at the port of shipment rather than the port of arrival the procedure would be greatly facilitated.

(6) The Officer in Charge, Wood Preservation Section, Forests Products Division, Commonwealth Scientific and Industrial Research Organization prepared a series of ten questions relating to *Sirex*. Answers to these questions were obtained from well-known authorities in Europe, and these are now submitted.

(7) Sample boards taken from a shipment of timber loaded in a Finnish port and discharged at Melbourne are submitted. These have a large amount of bark adhering to them which could provide shelter for borers and other insects.

(8) *Sirex noctilio* has become established in Tasmania, and there is a real danger that it may also become established on the mainland.

(9) An outbreak of *Sirex* would result in silvicultural losses ranging from loss of increment to death of stands. There would be further loss due to the cost of control measures such as introduction and culture of predators, capital cost of research stations, etc. Serious defects in timber as tunnelling, rot or stain can destroy the market for thinnings. This would mean that thinning of the forests could be done only at a financial loss. Timber which has been attacked by *Sirex* would be degraded from select to a very low grade or could become entirely unmarketable.

(10) Although the quarantine service was overloaded by heavy imports of softwood timber, it was responsible for only a small part of the delay to shipping which occurred in 1951. The rest of the delay was due to inertia and attempts by importers to break down quarantine restrictions.

By D. W. R. STEWART

(1) Evidence is given regarding exotic pine plantations in Western Australia. Existing areas are small, but two large projects are envisaged each with a final area of 100,000 to 120,000 acres.

(2) Throughout the world attempts to grow forests of introduced species have been accompanied by failures of varying degrees, and such failures have also occurred in Western Australia. The possibility of the introduction of an insect or fungus pest is more serious on account of "failed" areas in which the pest could most easily become established.

(3) Examples are given of heavy loss from pests introduced into various countries through lack or failure of quarantine. An example is also given of a forest pest introduced into Australia.

(4) From New Zealand's experience it appears that plantations in Southern Australia which are subject to long dry summers would be particularly vulnerable to *Sirex*. It is not uncommon for insect populations to increase suddenly to epidemic proportions when favoured with a particular set of circumstances, and such increase may cause very severe damage.

(5) Pure even-aged plantations are liable to very heavy loss should an injurious insect or fungal infestation become established. Australian plantations are particularly vulnerable in this respect.

By B. H. BEDNALL

(1) Information is given relating to the extent and value of exotic pine plantations in South Australia. South Australia has no natural forests of any consequence, and has embarked on a continuing planting programme which has resulted in the establishment of large compact areas of exotic species.

(2) Provided intermediate yields are secured, these plantations will eventually provide for almost all the timber needs of the State.

(3) Examples are given of serious damage caused to South Australian plantations by other insects. The protection of the plantations from *Sirex* and other insect pests is of paramount importance.

(4) Although *Sirex* was reported by a well-known forester as being present in South Australian forests some years ago, no evidence of its reappearance has since been noticed by any of the Department's staff.

(5) Unlike New Zealand, South Australia regards thinnings from the forests as being of great importance. The loss of this material could render ineffective all the State's management plans.

(6) It has been said that if proper attention is paid to strain and sound silvicultural rules, *Sirex* presents no danger. This has yet to be proved, and, even if successful action on these lines could be taken immediately, it would be many years before practical results could be secured.

By A. H. CRANE

(1) Evidence is given regarding action taken by the Forests Commission following the discovery of *Sirex* infestation at Pittwater.

By S. G. JENNINGS

(1) An area of about 15,300 acres of exotic species, principally *Pinus*, had been established in

Queensland before the end of 1951, and further plantings are projected at a rate of about 3,500 acres per annum.

(2) Information is given regarding quantities and value of timber that can be obtained from these plantations.

(3) The major centre of plantations is adequately linked with the Port of Brisbane by ornamental and roadside plantings. Imported insects could spread from the Port to the plantations.

(4) Many areas planted with exotic *Pinus* species were affected by the recent drought. The effect varied from loss of vigour to death of the tree. The reduced vigour may have made the trees particularly susceptible to insect attack.

(5) As far as possible the risk of attack by insect pests must be avoided.

Other Evidence in favour of Intensification or Maintenance of Existing Precautions

On behalf of Forestry Organizations other than Government Forest Authorities:

By L. McBain

(1) The Ballarat Water Commissioners have an area of two thousand acres available for afforestation purposes. At the present time there are 1,200 to 1,500 acres planted with trees principally of the *Pinus radiata* type. Evidence is submitted relating to the Commissioners' activities in the growing and milling of pine.

(2) It is recommended that all timber from those countries where any insect or fungus diseases exist should be subject to the most stringent inspection and treatment.

By J. D. Brooks

(1) Evidence is given relating to the activities of Australian Paper Manufacturers Ltd. and its subsidiaries to show why the Company is so concerned about the possibility of *Sirex* becoming established in Australian forests.

(2) A.P.M. Forests Pty. Ltd. has already planted 2,600 acres of *Pinus radiata* and intends to plant 4,000 acres in the coming season. It is the Company's intention to plant approximately 1,500 acres per annum, but during the next few years plantings will be somewhat larger.

(3) The introduction of a pest such as *Sirex* would possibly make plantation projects so risky as to become uneconomic. Quarantine precautions should be of such a nature that no potential forest pathogen or insect can be distributed from imported timber or wood products. Certificates of clearance from exporting countries would be useful in some cases, but there must be adequate checking in Australian ports.

(4) New Zealand's experience indicates that Australian plantations are liable to infestation by *Sirex* from timber imported through the main ports. The fact that *Sirex noctilio,* the species responsible for heavy damage in New Zealand, has not been identified in recent shipments to Australia, is of little importance.

(5) Once established *Sirex* could become an extremely dangerous pest capable of inflicting serious losses in Australian pine plantations. In this connection attention is drawn to the following:

(a) In New Zealand *Sirex* has reached epidemic proportions during periods of drought. In Australian plantations climatic conditions are much more severe and droughts much more frequent than in New Zealand.

(b) *Sirex* will not reduce stocking to the ideal level, but killing will go on until stocking reaches an uneconomic level. In a severe drought plantations could be practically wiped out. In Australia practically all thinnings from the plantations are used.

(c) For various reasons it is not possible to keep Australian plantations in the thinned condition in which they are apparently more resistant to *Sirex* attack.

(d) It is reported from New Zealand that it is not desirable to carry out silvicultural operations while *Sirex* is swarming. Postponement of these operations would cause considerable inconvenience and loss to A.P.M. Forests Pty. Ltd.

(e) *Sirex*-killed trees standing in the plantations would increase the already heavy fire risk.

(f) Victorian plantations are mainly *Pinus radiata,* and large tracts of single species would make plantations more susceptible to infestation.

(g) Wood pulp produced from fungus-attacked wood is inferior to that produced from clean wood.

(6) *Sirex* has become established in Tasmania, and steps should be taken to prevent its spread to the mainland. There should be either quarantine precautions against timber from Tasmania or an attempt should be made to eradicate the *Sirex* population entirely. If the latter course is possible it should be undertaken.

On behalf of Australian Sawmillers and Timber Merchants:

By F. F. Kraegen

(1) The Associated Country Sawmillers of New South Wales consider it most important that softwoods should be developed in that State. The New South Wales forests have been comparatively free from insect attack, and they should be kept that way.

(2) Every possible care should be taken to see that *Sirex*-susceptible timber is free from *Sirex* or any other dangerous pest before it leaves the country of origin. When exported to Australia such timber should be accompanied by a certificate to the effect that it is free from *Sirex* or that it has been treated prior to shipment by some method approved by appropriate Australian authorities.

(3) In addition the timber on arrival in Australia should be subject to stringent quarantine inspection, and if found to be infested should be treated or destroyed. If further infested timber is sent to Australia it should be traced to its source and further shipments from that country should not be admitted into Australia until steps are taken to prevent any recurrence.

By A. A. Swallow

(1) Damage to pine plantations by pest or disease can be of greater menace than fire. Fire-damaged trees can be used and further crops can be raised on the site of the fire, but the effect of pests may range from restricted tree growth to permanent extinction of plantations.

(2) Information is submitted relating to the development and activities of the two companies represented by the witness. Both these companies are engaged in the milling of *Pinus radiata* grown by the Victorian Forests Commission.

By J. W. Youl

(1) The Victorian Sawmillers' Association comprises

about 360 members who operate more than 400 sawmills. Of these 25 are exclusively engaged in cutting softwood, while 64 other mills cut both hardwood and softwood.

(2) Information is submitted regarding present output of logs and sawn timber and estimated future output from State plantations. Information is also submitted regarding kilns available in Melbourne.

(3) The Association considers that all imported softwood timber known to be highly susceptible to attack by *Sirex* should, prior to shipment to Australia, be kiln-seasoned at temperatures which would kill all traces of the wood wasp. A Government certificate should be issued in respect of all such timber. Kiln drying should relate to sawn timber, and also to timber used in cases, prefabricated houses, or in any other form. In addition, all timber likely to be infested with *Sirex* should be subject to regular and very strict quarantine inspection. Any infested timber should be treated or destroyed, and the country from which it came should be informed that no further shipments will be accepted until suitable arrangements are made to prevent any further infested timber being shipped to Australia.

(4) Compared with the present price of imported Baltic the amounts allowed by the Victorian Prices Commissioner for air-drying and kiln-drying are very small. It is customary for a very large part of the softwood timber produced in Australia to be heat-treated. In view of the comparatively low cost it would not be unreasonable to insist that imported softwood timber should be similarly treated.

(5) It has not been proved that *Sirex* will not attack vigorous trees. However, such trees would become susceptible in time of drought or if for any reason they were allowed to become over-mature. Even if *Sirex* confined its attack to thinning types of trees there would be great economic and financial loss in Victoria.

(6) The danger of *Sirex* attack in Australian forests has greatly increased in post-war years because of:
- (a) Large shipments of timber from *Sirex* infested forests in New Zealand.
- (b) Increased imports from Europe where *Sirex* is said to have increased in recent years.
- (c) Lower grade timber being imported from Europe.
- (d) Extensive planting of *Pinus radiata* in pure stands in Australia.
- (e) The fact that *Sirex noctilio* has become acclimatized in New Zealand and is increasing.

(7) Australian production of softwood timber has in recent years become a much larger part of total timber consumption in Australia than formerly.

By C. R. MATHER

(1) Statistics are submitted showing:
- (a) Production of timber in Tasmania;
- (b) Imports of timber into Tasmania;
- (c) Areas of exotic coniferous plantations in Tasmania; and
- (d) Estimated volume of round standing timber and estimated increment in exploitable softwood plantations.

(2) Rigorous steps should be taken to prevent the further entry of Siricid wood wasps into Australia. Tasmanian plantations are of comparatively recent establishment, and until recently the trees would be young and vigorous and not particularly susceptible to attack. However, the proportion of weaker and damaged trees is becoming larger, and in recent years the possibilities of attack have increased.

(3) Infested cargo arriving in Australia should be heat-treated, fumigated or otherwise suitably treated. However, the most desirable method of preventing the entry of Siricid wood wasps into Australia is to require that all softwood timber, likely to be infested, be heat-treated prior to export from the country of origin.

By W. R. GILBERT

(1) Every possible care should be taken to see that softwood timber imported from overseas is free from *Sirex* and other pests likely to attack Australian forests and plantations.

(2) Timber exported to Australia should be accompanied by a Government certificate that the timber is free of *Sirex* or that it has been treated before shipment. In addition, timber known to be liable to attack by such insects should be inspected on arrival in Australia, and if found to be infested should be subjected to such treatment as is necessary to destroy the infestation.

Other Evidence in Favour of Intensification:

By J. C. BANFIELD

(1) Evidence is given regarding the value of goods exported from Australia in softwood cases. If *Sirex* became established in Australian forests there would be a reduction in the Australian production of such cases.

(2) *Sirex* is more likely to be introduced into Australia in scantling and large billets than in sawn boards.

By N. H. HEARN

(1) Hearn's Industries Ltd. is engaged in the manufacture and sale of furniture. The Company produces its own plywood and corestock, and for this purpose uses mainly locally-grown *Pinus radiata*.

(2) The Company will in the future be very largely dependent upon locally-grown softwood, and it is urged that all necessary precautions be taken to prevent the entry of any pest which will detrimentally affect the supply of softwoods from Australian plantations.

By K. STEVENSON

(1) Evidence is given on behalf of Bryant & May Pty. Ltd., which purchases high-grade peeler logs of *Pinus radiata* for the manufacture of match sticks and match boxes.

(2) Timber infested with borer type insects or fungi would be unsuitable for the Company's purposes. At the present time there is an insufficient supply of peeler logs, and if *Sirex* became established in Australian forests the supply would be even smaller.

(3) Quarantine precautions should be such as to ensure that no forest pests are admitted into the country.

IN FAVOUR OF RELAXATION OF EXISTING PRECAUTIONS

On behalf of Timber Importers:

By F. M. HEWITT

(1) Baltic timber has been imported into Australia for very many years; in 1858 ten million super. feet of Baltic was imported into New South Wales. *Sirex* must have been imported into Australia in the large quantities of timber imported. The fact that specimens of *Sirex* have been obtained by scientific authorities proves that the insect must have been coming into this country before 1949.

(2) It has not been proved that *Sirex* is a dangerous forestry pest.

(3) The present methods adopted by the Quarantine authorities against *Sirex* are expensive to the country and are ineffective in their operation. The actual cost of heat-treating infested timber is 10s. to 15s. per 100 super. feet. In addition the consignee is frequently involved in demurrage

or extra wharf expenses because of his inability to move the timber.

(4) Measures which would be effective would completely paralyse Australia's import trade. It is submitted that the possibility of *Sirex* entering the country in the future, as it has done from time to time in the past, is no more than a calculated risk which has so far caused no harm whatsoever to the timber resources of this country.

(5) No other major timber-importing country in the world has adopted quarantine measures similar to those already in operation in Australia.

(6) All quarantine of timber should be dispensed with so that Australian importers can operate on equal terms in world markets.

C. E. LANE-POOLE

(1) A description is given of the finding of *Sirex* in imported timber in Sydney during the years 1949, 1950 and 1951.

(2) By the methods now employed it is impossible to prevent the distribution of timber infested with *Sirex* or other destructive forest and timber pests. The quantity of undetected infested timber imported during 1951 must have been great, and it is expected that as the larvae turn into wasps reports will be received of wasps being found in material already cleared by the Quarantine authorities.

(3) Since the middle of the last century Baltic timber has been imported in the form of sawn timber, as cases and crates and as dunnage, and *Sirex* must have been introduced into Australia on many occasions.

(4) In 1942 the witness saw the wasp working in the Mount Burr plantation in South Australia. The South Australian Woods and Forests Department, however, maintains thaa *Sirex* does not exist in its plantations, and a thorough search of New South Wales plantations in 1951 failed to reveal the presence of the wasp.

(5) There are other destructive insects more serious than *Sirex* imported into Australia.

(6) It appears that in New Zealand only sick trees are successfully attacked by *Sirex notilio*. In Australia there is a good market for thinnings, and for that reason it is unlikely that Australian plantations would ever be in the same unthinned condition as some of the New Zealand forests.

(7) The methods used by Quarantine authorities for dealing with insects introduced in timber are totally ineffective.

(8) The only method by which insects could be excluded from Australia would be practical prohibition of the importation of any timber from overseas. This prohibition would have to extend to cases and crates as well as sawn timber.

(9) The timber position in Australia is such that she must continue to depend on imported softwood timber until well into the next century. In view of this and the fact that the insects apparently have difficulty in establishing themselves in this country, it is considered that the quarantine service should be abandoned.

(10) Although present in New South Wales forests it was some considerable time before *Hylastes ater* was recognized by foresters in that State. In the same way *Sirex* may be present in Australian forests but may not have been recognized.

By F. R. O'CONNELL

(1) It is doubtful whether *Sirex* should be classed as a pest. Statements made by authorities on the subject suggest that *Sirex* is not considered to be a pest overseas.

(2) Australia has been importing timber from Europe for nearly 100 years, and there can be no doubt that during that period *Sirex* must have entered the country. As no trouble was experienced with Quarantine authorities until early in 1951 it must be concluded that *Sirex* imported into Australia:

(a) has failed to survive, or

(b) is present in Australian forests but has caused no damage, or damage so slight that it has never attracted the attention of the Forestry authorities.

(3) If sawn timber is to be subjected to quarantine, prefabricated houses, cases and crates, manufactures of wood and plywood must also be treated similarly. The treatment of cases might involve unpacking of costly and fragile articles on the wharf.

(4) There has been no uniformity in the inspection for *Sirex* in the various Australian ports.

(5) It is submitted that on account of:

(a) the impossibility of detecting the presence of the wasp in sawn timber by visual inspection;

(b) the impossibility of detecting the presence of the wasp in prefabricated house units, plywood and wooden cases generally;

(c) the insufficiency of Quarantine officials with suitable qualifications;

(d) the possibility of supplies to Australia being cut off by reason of quarantine regulations;

(e) the excessive charges for freight brought about by delays to vessels on account of quarantine regulations;

(f) the insufficiency of reconditioning chambers to treat timber alone, without considering prefabricated houses, cases, etc.;

(g) the damage caused to kilns by use in treatment;

(h) the unavailability of experienced labour for the kiln treatment;

(i) the insufficiency of the necessary fuel to ensure continuous operation;

(j) the excessive cost of handling, spraying and treating infected timber;

(k) the consequential wharf congestion by reason of the hold-up to ships and their cargoes;

the quarantine regulations should be immediately abandoned in their entirety.

By L. E. H. BAIGENT

(1) Details are given regarding the use of *Rhyssa persuasoria* and *Ibalia leucospoides* to overcome the attack of *Sirex* in the Nelson district in New Zealand. Technical evidence is also given regarding *Sirex* and the way in which it reached epidemic proportions in certain areas of New Zealand.

(2) The best defence against *Sirex* is to maintain all plantations in a clean, healthy, thriving condition. The Committee set up in New Zealand to deal with *Sirex* stated that the ultimate solution of the *Sirex* problem lay within the realm of silviculture, and that biological control would prove to be a useful help.

(3) In New Zealand there is no definite evidence of any tree having been killed by *Sirex*. Trees which are said to have been killed by *Sirex* have been killed by drought, unsuitable site, or other cause.

(4) If Australian exotic plantations are kept in a reasonably good, healthy condition, and a few *Rhyssa* parasites are regularly liberated to deal with any *Sirex* that may have entered the country, Australia

has nothing to fear from *Sirex*.

(5) With these precautions the only quarantine restrictions that would be needed would be a certificate of apparent immunity from *Sirex*. Routine inspections of timber and timber products should, however, be carried out to prevent the entry of insects other than *Sirex* that could become destructive.

(6) As *Sirex* can be present in timber and timber products without any outward sign, no benefit would be gained by intensification of visual inspection of imports. Because of heavy importations of timber and timber products it is improbable that *Sirex* and *Rhyssa* are not already established in Australia.

(7) It is considered that precautions taken in New Zealand to prevent the export to Australia of *Sirex*-infested timber would ensure that no *Sirex* reaches Australia from that country. New Zealand exporters would be prepared to supply a certificate that the timber, at the time of export, was apparently free from *Sirex*, and that the timber was cut from healthy trees in full vigour of growth.

Other Evidence in favour of Relaxation:

By G. J. COLLOPY

(1) It has not been proved that *Sirex* is as serious a pest as has been suggested. Moreover, adequate quarantine precautions would involve prohibitive expense and practically complete stoppage of softwood imports.

(2) Many millions of wasps must have already entered the country, and if it is going to attack Australian plantations it should have already done so.

(3) Quarantine inspection should therefore be reduced to a minimum.

By M. POLLOCK

Intensification of the quarantine regulations will result in great economic loss to most importers, and will cause an increase in the price of commodities now selling on the market.

GENERAL EXPERIENCE

By MRS. Q. SAMBLEBE

Evidence is given regarding action taken by the Swedish Government and various organizations including the Swedish Wood Exporters' Association following complaints by the Director of Plant Quarantine that insect-infested timber had been exported from Sweden to Australia.

By J. H. HILLSTON

(1) Hemlock, spruce and pine from Canada, the United States of America, Sweden, Finland and Norway, as well as South European countries, are all susceptible to infestation with the Siricid wood wasps, and any measures adopted will have to apply to all such timber imported into Australia.

(2) Roumanian timber has always been considered to be of very high quality, and in recent shipments the high quality has been maintained or improved. If timber could be marketed under the names of the various countries of origin, it would be a fair reward to those exporters who were trying to conform to quarantine requirements, and would lead to the elimination of low quality timber from the Australian market.

(3) Shipments of timber from Roumania have shown only slight infestation, and could be considered only a very slight danger to Australian forests compared with the millions of cases and crates imported from overseas.

(4) Details of discussions held with the Director of Plant Quarantine on the subject of *Sirex* are submitted.

(5) It is impossible to guarantee that a shipment of timber is completely free from *Sirex*.

(6) The heat-treating in Roumania of timber exported to Australia would necessitate the erection of special kilns. Timber shipped to Australia would be the only timber treated in these kilns, which would therefore be idle for very long periods.

(7) Australia has, for many years, been importing timber likely to be infested, but *Sirex* has not yet become established in Australian plantations. A possible explanation of this is contained in an opinion from the Director of the Institution for Forestry Research in Bucharest which is submitted.

(8) Quarantine precautions should be continued, but it should be realized that unless shipments show heavy infestation they do not constitute a danger to our forests. If a shipment is condemned as being infested the importer should have the right to appeal.

(9) The State Company for Foreign Trade in Roumania is prepared to issue certificates to accompany each future shipment of timber that most stringent measures have been taken to ensure that:

1. Only healthy and vigorous trees have been felled;
2. Only recently-cut logs have been milled;
3. At the thorough inspection of the boards at the mills and prior to shipment no apparent *Sirex* infestation has been detected.

APPENDIX III

LIST OF PERSONS WITH WHOM THE COMMITTEE DISCUSSED ITS INQUIRY WHILE IN NEW ZEALAND

Officers of the New Zealand Forest Service:

Mr. A. R. Entrican, Director of Forests.
Mr. A. L. Poole, Assistant Director of Forests.
Mr. Perham, Conservator, Auckland Conservancy.
Mr. D. Dun, Conservator, Rotorua Conservancy.
Mr. J. F. Lysaght, Assistant Conservator, Rotorua Conservancy.
Mr. Biggs, Assistant Conservator, Wellington Conservancy.
Mr. H. V. Hinds, Forester, and Acting Officer in Charge, Forest Research Institute, Rotorua.
Mr. G. B. Rawlings, Forest Pathologist and Entomologist.
Mr. W. Jolliffe, Forester and Officer in Charge, Sand Dune Reclamation.
Mr. P. Mapleston, Forester.
Mr. A. Greyburn, Forester.
Mr. T. S. Thompson, Forester.
Mr. W. Boardman.
Mr. W. C. Ward, Inspector in Charge, Commercial Division.
Mr. F. D. Morgan, Senior Timber Inspector.
Mr. J. W. Syme, Manager, Waipa State Sawmill.

Officer of the Industries and Commerce Department:

Mr. T. Hazelwood.

Representatives of New Zealand Forest Products Ltd.:

Mr. D. Henry, Chairman and Managing Director.
Mr. M. R. Buckett, Assistant General Manager.
Mr. J. T. Currie, Forest Superintendent.
Mr. F. E. Hutchinson, Assistant Superintendent.
Mr. Moorhouse, Forest Administrator.
Mr. Owen Jones, Consultant Forester.
Mr. H. Kilgour, Superintending Engineer.
Mr. A. W. Mackney, Chief Chemist.
Mr. M. J. Matheson, Assistant Chief Chemist.
Mr. A. M. King, Sales Manager.
Mr. L. Tidmarsh, Public Relations Officer.

Representatives of Other Private Organizations:
Mr. R. Butterworth, Manager, Whakatane Board Mills Ltd.
Mr. S. Anderson, Officer in Charge, Matahina Plantation, Whakatane Board Mills Ltd.
Mr. Harrison-Smith, Forester, Matahina Plantation, Whakatane Board Mills Ltd.
Mr. A. E. McCracken, Manager, Ellis & Burnard.
Mr. A. L. Mason, Manager, Putaruru Timber Yards.
Mr. A. Seed, President Dominion Sawmillers' Federation.
Mr. T. D. Ward, Secretary, Dominion Sawmillers' Federation.
Mr. P. Baigent, H. Baigent & Sons Ltd.

Officers of the Cawthron Institute, Nelson:
Dr. D. Miller, Assistant Director.
Mr. Gourlay, Entomology Section.

Officers of the Division of Scientific and Industrial Research:
Mr. L. J. Dumbleton, Entomology Division.
Mr. Bannister, Botany Division.

APPENDIX IV

Instances in which SIREX *has been found in Imported Timber, Prefabricated Houses and Other Goods imported into Australia.**

Date	Ship	Origin	Infested Materials
New South Wales			
19th April, 1949	Not given	Czechoslovakia	Baltic Timber
15th Feb., 1951	Marilen	Roumania	European Whitewood
2nd April, 1951	Pater Dal	Czechoslovakia	European Whitewood
2nd April, 1951	Trident	Czechoslovakia	European Whitewood
16th April, 1951	Cannaregio	Austria	European Whitewood
21st April, 1951	Erviken	Not given	Timber
16th May, 1951	Menelaus	Not given	Not given
20th May, 1951	Australia	Not given	Prefabricated Houses
27th May, 1951	Ravello	Not given	Prefabricated Houses
1st July, 1951	Marineri	Roumania	European Whitewood
July, 1951	Hans P. Cahl	Austria	Prefabricated Houses
28th July, 1951	Ata	Yugoslavia	European Whitewood
16th August, 1951	Marmella	Austria	European Whitewood
31st August, 1951	Lugumo	Not given	Prefabricated Houses
25th April, 1952	Huseyin Kaptan	Czechoslovakia	European Whitewood
Victoria			
June, 1925	Not given	Not given	Timber
April, 1951	Marilen	Not given	Timber
April, 1951	Mongolia	Not given	Timber
April, 1951	Monkay	Not given	Timber
April, 1951	Wye Valley	Not given	Timber and Prefabricated Houses
May, 1951	Annam	Not given	Timber and Prefabricated Houses
May, 1951	Annenkerk	Not given	Timber
May, 1951	Ravello	Not given	Prefabricated Houses
May, 1951	Cannaregio	Not given	Timber
May, 1951	Talabot	Not given	Timber
July, 1951	Ata	Not given	Timber
August, 1951	Aldebaren	Not given	Prefabricated Houses
Oct., 1951	Langlee Clyde	Not given	Timber
Oct., 1951	Royal Star	Not given	Prefabricated Houses
Oct., 1951	Penrith Castle	Not given	Prefabricated Houses
Nov., 1951	Roma	Not given	Prefabricated Houses
Dec., 1951	Tebro	Not given	Timber
March, 1952	J. E. Manne	Not given	Timber
March, 1952	Marineri	Not given	Timber
March, 1951	Piri	New Zealand	Timber
Queensland			
March, 1910	Not given	Not given	Wooden core of a roll of serge
15th March, 1952	Venezia Giulia	Italy	Prefabricated Houses
2nd May, 1952	Pei Ho	France	Prefabricated Houses
South Australia			
March, 1949	Mangarella	Sweden	Baltic Deal
March, 1951	Mongolia	Sweden	Baltic Deal
April, 1951	Mattawunga	Sweden	Baltic Deal
May, 1951	Talabot	Sweden	Baltic Deal
May, 1951	Birbraken	Germany	Outside Cases
May, 1951	Korea	Sweden	Baltic Deal
August, 1951	Hermion	Sweden	Baltic Deal
Sept., 1951	Nordanbris	Sweden	Wasp found among Baltic Deal but no timber found to be infested
April, 1952	General Guisan	Germany	Dunnage
May, 1952	Admiral Codrington	Germany	Wasp found among prefabricated houses but no timber found to be infested
May, 1952	Langfoon	Sweden	Wasp found among Baltic Deal but no timber found to be infested
May, 1952	Dolius	Germany	Wasp found among prefabricated houses but no timber found to be infested
Western Australia			
Nov., 1951	Maria Luisa	Trieste	Prefabricated Houses
March, 1952	Muncaster Castle	Belgium	Dunnage
April, 1952	Polifemo	Trieste	Prefabricated Houses
Tasmania			
May, 1951	Arabia	France	Prefabricated Houses
August, 1951	Korea	Holland	Prefabricated Houses

* On many occasions Quarantine inspectors have treated or destroyed cases and crates manufactured from timber which was or had been infested with *Sirex*. These, however, have not been included in this Appendix, but it is interesting to note that the goods included in the cases were exported from the United Kingdom, the continent of Europe, North America and Japan.

APPENDIX V

REPLIES GIVEN BY CERTAIN EUROPEAN AUTHORITIES TO QUESTIONNAIRE PREPARED BY MR. N. TAMBLYN, OF THE DIVISION OF FOREST PRODUCTS, COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION

The authorities from whom replies were received were as follows:

Dr. R. C. Fisher, Forests Products Research Laboratory, Princes Risborough, Aylesbury, Bucks, U.K.

Mr. R. B. Benson, Department of Entomology, British Museum (Natural History), Cromwell Road, London, U.K.

(Note.: Mr. Benson replied that he had little to add to the information he had already published in Bull. Ent. Research 34 pp. 27-51 (1943). This information is not reproduced in this Appendix, but reference is made to it in other sections of this report.)

Dr. R. N. Chrystal, Imperial Forestry Institute, Oxford, U.K.

Mr. H. S. Hanson, Forest Entomologist, Forestry Commission, Forest Research Station Wrecclesham, Farnham, Surrey, U.K.

Prof. R. Joly, Ecole Nationale des Eaux et Forets, Aix les Bains (Savoie), France.

Prof. P. Vayssière, Museum National d'Histoire Naturelle,

Entomologie Agricole Coloniale, Paris, France.
Dr. Gunther Becker, Jagerstrasse 18 B, Berlin-Lichterfelde-O. (Information obtained through the Food and Agriculture Organization of the United Nations.)
Department for Protection of Forests, Ministry of Silvicultural Management, Bucharest, Roumania.

QUESTION 1

To what extent do Ecological Conditions, such as Climate, Drought, Forest Fires, etc., affect SIREX *Infestation in Europe?*

REPLIES

Dr. Fisher: Sound, healthy trees are not attacked; infestation is associated with decrease in vigour of trees or plantations resulting from unsuitable soil conditions, drought, surface forest fires, or "freak" silvicultural operations leading to accidental damage to trees. Plantations and trees younger than pole stage are not affected.

Dr. Chrystal: It is not possible to reply to this question in detail as far as Europe is concerned. There are no data available, as far as we know. *Sirex* is not regarded as a major forest timber pest in Europe. Even in the coniferous area of Sweden, Central Europe and Southern France, where insect outbreaks have occurred as an aftermath of war conditions, or storm damage, the wood wasp has not been one of the major insects to which special attention has been directed.

In general, however, the attractiveness of a tree for *Sirex* is conditioned by the presence of any factors which produce a decline from the state of "full vigour". As far as forest fires are concerned, it is highly probable that other borers, such as longhorns and weevils, are attracted to the trees before the wood wasp is.

Mr. Hanson: Ecological conditions play an important part in facilitating or restricting the development of *Sirex* populations in any given locality. The moisture content of the timber is an important factor in determining whether living trees may be successfully utilized by *Sirex* for breeding purposes. Prolonged periods of drought seldom occur in this country, but, in localities where severe drought does occur and the subsoil water level is seriously affected, trees growing on light, shallow soils may become suitable for breeding purposes. On the other hand, during periods of continuous wet weather, the roots of pine and larch trees growing on badly-drained sites and waterlogged soils are liable to be adversely affected and develop root rot, resulting in a tendency to die-back of the crowns and susceptibility to attack by *Sirex*. Abnormal climatic conditions may also result in extensive windfalls or snowbreak, thus providing exceptionally favourable breeding facilities.

Small surface fires which scorch the upper roots and the base of the stems may also reduce trees to a state in which they become suitable for breeding purposes. On the other hand, fierce forest fires generally render the timber unsuitable for breeding purposes.

The stems and crowns of trees suffering from the effects of root fungi are particularly susceptible to the attack of *Sirex* during the early stages, but portions of the timber invaded by fungus mycelium are quite unsuitable for breeding purposes.

Trees severely defoliated by insects, or whose roots are attacked by *Hylastes* bark beetles, are liable to become infested by *Sirex*. Trees damaged by lightning or with the bark and cambium injured as a result of sudden exposure to direct sun scorch after growing in a sheltered shady situation are also liable to attack.

The various species of *Sirex* and *Urocerus* are not regarded as important forest pests in Britain or in Europe, and seldom become very numerous in any locality. Under normal forest conditions they are controlled at a relatively low level of population density by the combined attack of the Ichneumonid parasite *Rhyssa persuasoria* L., and the Cynipid parasite *Ibalia leucospoides* Hockens. Temporary increase in the local population in any given locality may take place from time to time as a result of various combinations of the factors referred to above, or when quantities of coniferous logs are left lying in the forest or in dumps in sawmill yards.

Prof. Joly: The problem has shown itself much simpler in Europe where *Sirex* does not attack healthy standing trees. All the species and specially those which are parasitic to softwood readily attack:

(1) Trees felled in the spring but not barked, and
(2) Very backward standing trees.

Those species which are parasitic to hardwood are very rare, and infestation is very exceptional.

Prof. Vayssière: Normally *Sirex* is found in mountainous regions, although some captures have been recorded in the coniferous forests of the plains. No other ecological condition appears to have any bearing on this subject.

Roumanian Ministry of Silvicultural Management: The *Sirex* wasp is a secondary insect which deposits its eggs on trees which vegetate badly, on sick trees, damaged trees and trees recently felled. All ecological factors which result in the trees becoming sick can result in heavier infestation by the *Sirex* wasp. Droughts if lasting for several consecutive years, and fires causing partial drying up of the trees, favour the infestation by *Sirex*. Trees felled by storms are excellent media for the *Sirex* to develop if this material is left in the forest over the summer.

QUESTION 2

To what extent does the Age and Health of the Tree affect Its Susceptibility to SIREX *Attack? Are Young or Healthy Trees often attacked?*

Dr. Fisher: See answer to Question 1.

Dr. Chrystal: We have no records of trees younger than the pole stage being attacked by *Sirex*. It is true that trees which look capable of further growth may be attacked. We found this to be the case with larch, attacked by *S. cyaneus* in the South of England. But such trees were definitely not to be classed as being in "full vigour". The conditions reported by Rawlings in New Zealand have not, so far, appeared in Britain, nor have we any Continental records of such attacks.

Mr. Hanson: Over-mature trees are very susceptible to attack, especially when they have begun to die back at the top and tend to become stagheaded, as in the case of many large trees which are for sentimental reasons allowed to remain standing in parks or on private estates. Young trees growing on suitable soils and situations, under either natural or sound silvicultural conditions, will normally be healthy and immune from *Sirex* infestation so long as this combination of circumstances continues. But even where soil and other locality factors are ideal for successful growth, freak silvicultural operations such as a sudden heavy thinning accompanied by severe pruning of green branches, or damage to surface roots and the bark and cambium around the base of the stems by tractors during the careless extraction of thinnings, may predispose the trees to destruction by bark beetles, wood-boring insects including *Sirex* or injurious fungi.

Young pines growing under conditions favourable for exceptionally rapid growth are less hardy, and more susceptible to the effects of adverse changes in the environment, than when growing at a slower rate under more exacting general conditions; they react more violently to abnormal external influences, and are more liable to collapse when subjected to maltreatment.

Prof. Joly: See Answer to Question 1.

Prof. Vayssière: Trees are susceptible to attack whatever

may be their age and state of health; nevertheless, dying trees are more susceptible; but the insects never attack rotten wood.

Dr. Becker: The Siricidae attack neither healthy trees nor dry timber. Infestation is caused and encouraged by sickness, extremely poor conditions for the trees, and wounds on them. Fresh felled trees and stumps and dead wood of sufficient humidity are commonly attacked.

Roumanian Ministry of Silvicultural Management: From our knowledge of local conditions we can assert that the *Sirex* wasp attacks trees of large and medium thicknesses. It has not been observed that *Sirex* attacks young trees. At the same time it has not been observed that the *Sirex* attacks well-cared-for forests with healthy trees.

Question 3

What are the Main Species of Sirex *and* Urocerus *occurring in Europe, and what is their distribution (in Europe) with regard to Broad Geographic Localities?*

Replies

Dr. Fisher: Distribution in general coincides with natural range of conifers.

Mr. Hanson: The exact range in geographical distribution of the various species of *Sirex* and *Urocerus* in Europe, or even in Great Britain, is not definitely known. Certain species are normally associated with northern latitudes while other species have a more southerly range, but there is considerable overlap in the distribution of certain species. It will be safe to assume that the general distribution coincides with the natural range of coniferous crops both as regards latitude and elevation, but this does not necessarily mean that the insects will be present in all localities within the normal range of natural coniferous forests, or in any particular district in which coniferous trees have been planted.

Prof. Joly: As with all other insects, the hot and dry years from 1945 to 1949 favoured the propagation of *Sirex*, and I give you the following list:

1. *Xiphidria prolongata* Geoffr. (Salix, populus, ulmus).
2. *Xiphidria camelys* L. (Alnus, betula).
3. *Xiphidria longicollis* Geoffr. (Betula, Quercus, Acer, Pinus).
4. *Tremex fuscicornia* T. (Fagus, Betula, Populus).
5. *Tremex Magnus* F. (Quercus, Fagus, Acer, Betula, Pinus).
6. *Xeris spectrum* (Pinus, Picea, Abies).
7. *Paururus juvencus* L. (= *noctilio*) (Pinus, Picea, Abies).
8. *Sirex gigas* L. (Pinus, Picea, Abies, Larix).
9. *Sirex phantoma* T. (Pinus, Picea, Abies).
10. *Sirex augur* Kig. (Pinus, Picea, Abies).

Paururus juvencus L. and *Sirex gigas* are the most abundant: they are common throughout Europe. *Juvencus* exists also in U.S.A. and Canada.

Gigas is found also in Central Asia.

Prof. Vayssière: Species having an economic importance are: *Sirex* (*Urocerus*) *gigas, S.* (*Xeris*) *spectrum, S. juvencus, S. noctilio.* These four species are considered as having the same geographical distribution in Europe —the whole continent, including the three peninsulas (Spanish, Italian, Scandinavian). They also occur in Asia.

Roumanian Ministry of Silvicultural Management: The species of *Sirex* observed in Roumania are *Sirex gigas* and *Sirex juvencus,* and they are found in our forests of "Molid" (*Picea excelsa*) and "Brad" (*Abies pectinata*) in the mountainous regions.

Question 4

Are Different Species of Sirex *Specific to Certain Timbers? Which Coniferous Species are most susceptible? Are Hardwoods (Broad Leaf Trees) ever attacked in Europe?*

Dr. Fisher: *Sirex* is not absolutely specific in relation to host trees but sometimes shows preference for certain timbers, e.g. *S. cyaneus* in larch, *S. gigas* in Scots pine, but both attack silver fir and spruce. Genera of the subfamily Tremecinae are associated with hardwoods (e.g. *Tremex* sp. in beech and oak on the Continent but uncommon); subfamily Siricinae affect conifers only.

The genus *Xiphydria* mentioned by Mr. Hanson belongs to a different family (Xiphydriidae), and affects alder and willow, but is of no forest importance.

Mr. Benson: The Tremecinae are entirely associated with hardwoods and the Siricinae entirely with coniferae, and only the family Pinaceae except for one N. American *Urocerus* on the Taxodiaceae. It seems therefore very unlikely that any of the species introduced would attack any native Australian trees, but only introduced Pinaceae.

Dr. Chrystal: The *Sirex* species, while not, as far as we know, absolutely specific to one species of conifer, do nevertheless show tendencies or preferences for certain trees. Thus *S. cyaneus* in the South of England showed a marked preference to larch, while the common species, *S. gigas,* was more commonly associated with *S. pine.* On the other hand, both species are found attacking silver fir and spruce.

In the case of the hardwoods the wood wasps of the genus *Tremex* attack beech and oak in Europe. They do not occur in Britain, and are not very common on the continent as far as we know.

Mr. Hanson: The various species of *Sirex* are definitely not specific for certain tree species; although some species may have a preference for particular host trees they will readily breed in the timber of other coniferous trees if the necessity arises.

Larch, silver fir, spruce and pines are all susceptible to attack, particularly trees felled during the *Sirex* breeding season, but other species such as cedar or Douglas fir are also susceptible to attack if in a suitable condition.

European species of *Sirex* and *Urocerus* normally confine their attention to coniferous timber, but specimens have been observed to attempt oviposition in hardwood timber; for example, I recently saw *Sirex cyaneus* attempt to insert its ovipositor into the teak framework of a breeding cage. Allied species of the genus *Xiphidria* normally breed in the timber of certain broadleaf trees, and American species of the genus *Tremex* breed in hardwoods.

Prof. Joly: See answer to Question 3.

Prof. Vayssière: *S. gigas* has been recorded on Pinus, Picea, Abies, Larix and also on Populus and Fraxinus, but there may have been an error in the determination of the noxious species for these two cases.

Dr. Becker: The genera *Sirex, Paururus* and *Xeris* attack only softwood (conifera). Species of the genera *Xiphidria* and *Tremex,* normally living in hardwoods, are said to attack sometimes also softwoods.

Roumanian Ministry of Silvicultural Management: In Roumania *Sirex* attacks the "Molid" (*Picea excelsa*) and the "Brad" (*Abies pectinata*) trees. The *Sirex* does not attack broad-leaf trees in our forests.

Question 5

Is Sirex *Infestation heavier than usual in Europe at the present time? If not, what is the probable explanation for the Unusually Heavy Infestation in European Softwood Timbers now being imported into Australia?*

Replies

Dr. Fisher: No specific data are available, but it seems pos-

sible that conditions following the war have led to an increase in population of *Sirex* in some countries, particularly where extraction and conversion of timber have been delayed. It is quite possible that the presence of *Sirex* could be overlooked in converted timber. Forest Products Research Laboratory records do not indicate that there has been any increase of infestation by this insect in the United Kingdom.

Dr. Chrystal: There are no specific data available on this question as far as Europe is concerned. It is quite possible, however, that as a result of the war conditions existing throughout Europe for more than a decade, there has been a great neglect of proper forest care and management. This might easily allow, in many areas, the building-up of a large wood wasp population, and it is possible that the timber which is now being exported to Australia has come from such areas. It would be possible for such timber to be exported from its country of origin without the fact that it was wood wasp infested being specially remarked.

Mr. Hanson: There is no evidence that *Sirex* infestation is heavier than usual in European forests at the present time. On the contrary, the insects are probably less numerous in many localities than during the war period. *Sirex* is definitely a rare insect in most parts of Britain as compared with twenty years ago, partly because suitable breeding material is less abundant, and in most localities the *Sirex* population is controlled at a low level of density by resident parasites.

The most probable explanation for the unusually heavy infestation in European coniferous timber now being imported into Australia might be the presence in the shipments of a high proportion of timber from windfall areas in which breeding facilities for *Sirex* are generally very favourable. On the other hand, trees growing in the vicinity of such sources of infestation, if felled and left lying in the forest during the *Sirex* breeding season, would attract large numbers of recently emerged wood wasps, and the fresh felled timber might in turn become heavily infested before removal from the forest. Similarly fresh felled logs lying in sawmill dumps are liable to become infested if a suitable source of infestation exists in the vicinity.

Prof. Joly: See answer to Question 3.

Prof. Vayssière: It is my personal opinion that there is at the present time an increase of *Sirex* infestation in Europe.

Dr. Becker: *Sirex* infestation in Europe increased on account of war influences (by hurting of trees), long storing of cut poles in the forests, insufficient drying and using of fresh untreated wood.

Roumanian Ministry of Silvicultural Management: In Roumania no unusually heavy infestation by *Sirex* has been observed in the last years. But in the year 1947-48 unusually heavy storms uprooted a large number of trees which could not be removed in time, and this has caused a larger infestation in some forests. We have taken ample steps to prevent and combat all timber-damaging insects which could have developed as a result of these windfalls. This work has been directed and controlled by the Special Service for the Protection of Forests. In fact this problem is a permanent preoccupation of this service.

These measures are being supplemented by a very thorough check in the sawing mills with a view to eliminating any pieces which might have been attacked by *Sirex*.

Question 6

Can you suggest any reason why Sirex noctilio *is the only European Species which has succeeded in becoming well established in* Pinus radiata *Plantations in the Temperate Climate of New Zealand?*

Replies

Dr. Fisher: No satisfactory explanation is forthcoming, but it is possible that the establishment of *S. noctilio* in New Zealand is connected with the preference of this insect for young trees with thin bark. *S. gigas* is stated in Germany to be one of the species attacking larger stems where the bark is thicker. Until the publication of Mr. Benson's paper there has always been considerable confusion in the precise identification of species and genera of wood wasps.

Dr. Chrystal: One can only hazard a guess as to the reason for this. It is possible that the timber in which this wood wasp was originally introduced into New Zealand came from an area where this species was in the majority, and well established.

The fact that it has found the "young pine" conditions in New Zealand to its liking is probably connected with tree size and bark thickness. Scheidter (1923) in Germany states that the species *S. gigas* and *S. augur* attack the biggest stems, whereas *S. noctilio* and *S. juvencus* prefer poles probably because their shorter ovipositors cannot deal effectively with the thick bark.

Mr. Hanson: It is by no means certain that *Sirex noctilio* is the only species established in the extensive *Pinus radiata* plantations in New Zealand. In a recent letter to me Mr. G. B. Rawlings, who is at present working on *Sirex* control in New Zealand, stated that he was not at all satisfied as to the exact identity of the species. Earlier writers referred to the introduced species as *Sirex juvencus*, and this is the species mentioned in the Annual Report of the Director of Forestry in New Zealand, 1930. There is no reason to suppose that the earlier identifications were not correct. Considering the difficulty of distinguishing the species it seems probable that both may be present: in fact it seems quite likely that other species may also be present. In a paper published in 1935 Dr. D. Miller and A. F. Clark stated that other species of the genus are sometimes met with in shipments of Californian redwood and in other timbers from the Pacific coast of the United States. Any one of the introduced species may have become established, just as new species of sawflies and other insects are constantly becoming established in Britain. Even in the relatively small blocks of forest in this country it is not possible to state with certainty that any particular species is absent. The position must be infinitely more uncertain in New Zealand.

Prof. Vayssière: I can definitely not give you any reasons explaining why *S. noctilio* has adapted itself better to *Pinus radiata* in New Zealand, and I am wondering whether it is really this species which is certainly less common in Europe than *S. juvencus*, and with which it is very often confused.

Roumanian Ministry of Silvicultural Management: In Roumania we have no large plantations of Pinus; the small plantations of Pinus do not produce timber for export. We assume that *Sirex noctilio* would attack *Pinus radiata* because *Sirex noctilio* is a species which attacks in Europe *Pinus silvestris*.

Question 7

In Europe is Initial Attack restricted to the Standing Tree, or can Sirex *commence and complete its Life-cycle in Fallen Logs and Sawn Timber?*

Replies

Dr. Fisher: Both unhealthy standing trees and felled logs are suitable for infestation by *Sirex*. Attempted oviposition occurs in sawn lumber, but it is very doubtful whether life cycle can be completed except by larvae already present in the timber at the time of conversion. There are records in the United Kingdom of emergence

of wood wasps from timber in buildings, but they are comparatively rare.

Dr. Chrystal: Attack is usually started in standing trees, but the insect can attack and complete its life-cycle in fallen trees. While its larval stage can, of course, carry on in sawn timber, we do not know whether oviposition can actually take place in such timber.

Mr. Hanson: The initial attack of *Sirex* is definitely not restricted to standing trees. The insect can and frequently does commence and finish its life-cycle in fallen logs. As stated in answer to Question No. 5, fresh-felled coniferous timber of any species is liable to infestation, and the life cycle may begin in round logs but may subsequently be completed in sawn timber, in some cases after the material has been utilized for constructional purposes, or even for manufacture.

Recently converted timber when in a suitable condition is also liable to infestation, but whether the larvae complete their development depends on a variety of factors, and the length of the life cycle will depend on the type of material and moisture content. Mortality as a result of desiccation may occur at an early stage in small scantling which dry out rapidly.

Prof. Joly: See answer to Question 1.

Prof. Vayssière: In Europe *Sirex* oviposits in standing or recently-felled trees which have not been barked. The larval cycle proceeds for one or two years, during which time the wood may be converted, and that is why it happens that *Sirex* emerges in houses from various boards such as library bookshelves.

Roumanian Ministry of Silvicultural Management: The *Sirex* wasps attack standing sickly trees, as well as trees uprooted by storms, and also felled trees which have not been removed from the forest in time. If such trees are cut up into boards, the *Sirex* would continue its life cycle in the timber after such timber has been made into window sashes, doors, etc. It has never been observed that *Sirex* would infest sawn timber.

Question 8

Recent New Zealand work suggests that parthenogenetic reproduction may occur with SIREX NOCTILIO. *It might greatly increase the danger of establishment in Australia if Unfertilized Females were capable of Reproduction. Is there evidence that this occurs in Europe?*

Replies

Dr. Fisher: There are no published accounts of parthenogenetic reproduction, but there are records of egg-laying by some unfertilized species, e.g. *S. cyaneus*. I have no knowledge of work on this subject in Europe.

Dr. Chrystal: We have noted that unfertilized females of *S. cyaneus* are capable of egg-laying. We have not, however, pursued the matter further, nor do we know of any work which has been carried out in Europe on this subject in the case of the wood wasp. In the sawflies (tenthredinidae) parthenogenesis is common, and the resultant broods may be either all male, all female, or mixed. If *Sirex* exhibits the parthenogenetic habit, one cannot therefore exclude the possibility of such production of both sexes.

Mr. Hanson: It is known that under laboratory conditions some species of *Sirex* are capable of parthenogenetic reproduction, and it seems probable that all the species may reproduce in this way when necessary. It is not definitely established that parthenogenetic reproduction invariably results in male progeny, but this seems probable.

Prof. Joly: I do not know of the parthenogenetic reproduction of the species in Europe.

Prof. Vayssière: I have never heard it said in Europe that *Sirex noctilio* may be parthenogenetic. I should be very pleased to know the reference to the observation made in New Zealand.

Dr. Becker: I cannot say anything about parthenogenesis in Siricidae.

Roumanian Ministry of Silvicultural Management: We have no knowledge of a parthenogenetic reproduction of *Sirex noctilio.*

Question 9

It is claimed in New Zealand that the fungus (species not identified) carried by SIREX NOCTILIO *is mainly responsible for the death of an infested tree. Is this also the case in Europe with various* SIREX *species?*

Replies:

Dr. Fisher: There is no information available to confirm New Zealand thesis that death of trees is directly caused through infestation by *Sirex* or as a result of inoculation of the fungus (*Stereum* sp.) found to be associated with adults, eggs and larvae (females) of *S. cyaneus* and *S. gigas.*

Dr. Chrystal: We have found, in Britain, that *S. cyaneus* and *S. gigas* carry a fungus which is transmitted through the larvae. This work has not, however, been carried any further, and we do not know of any work which has been done in Europe comparable to that which is being done in New Zealand at the present time. We have not associated *Sirex* with such young plantations.

Mr. Hanson: So far as I know, there is no authentic evidence of *Sirex,* or an associated fungus having caused the death of any tree either in this country or in Europe. *Sirex* larvae do cause structural damage, and the extent of this depends on the degree of infestation. Similarly infestation may facilitate premature decay of the timber. The condition of the *Sirex*-infested timber recently imported from Europe should provide all the evidence desired on this point.

Prof. Joly: I do not know of the death of trees from fungi carried by *Sirex.*

Prof. Vayssière: In France there is no evidence to my knowledge of the propagation by *Sirex* of a noxious fungus; in Italy a fungus named *Aecidium elatinum* has been recorded.

Dr. Becker: Caused by the holes of the wood wasps being filled with fine wood particles, the humidity of the timber increases, and development of wood-destroying fungi is encouraged. The wood wasps are also associated with certain fungi of lower destroying influence on the wood.

Roumanian Ministry of Silvicultural Management: Up to the present we do not know of cases in which trees attacked by *Sirex* would dry up. We also do not know of cases in which trees would dry up because of the fungus carried by *Sirex.* As we have no large forests of Pinus in Roumania we cannot offer observationos regarding *Sirex noctilio.*

Question 10

Can you recommend any Treatment other than Heat Sterilization for large shipments of SIREX*-infested Timber from Europe. If Timber is sprayed with D.D.T. or B.H.C. while awaiting heat treatment, would the emerging wasps be likely to remain on the treated surface for long enough to become affected?*

Replies:

Dr. Fisher: Treatments for the control of infestation by *Sirex* wood wasps either in the forest or in the timber yard are not undertaken in the United Kingdom. No information from experiment is therefore available. In the opinion of Forest Products Research Laboratory, heat sterilization is likely to be the most reliable and effective means of eradication of the insect in lumber. Recent work by the New South Wales Forestry Commission suggests that methyl bromide might under certain circumstances be an effective fumigant, but comments by

Mr. Burnes-Browne, in charge of fumigation work at Pest Infestation Laboratory, London Road, Slough, do not support general use of fumigation for eradication of *Sirex* in bulk store timber. The suggested treatment is likely to be effective for destroying adults emerging in confined spaces, but it is questionable whether larvae within timber would be reached. No information is available on degree of susceptibility of *Sirex* spp. to such insecticides as D.D.T. or benzene hexachloride. Experiments by Rawlings in New Zealand suggest that these are ineffective, but further investigation would appear justifiable. Experience in the United Kingdom shows that during egg-laying, *Sirex* remains on surface of logs possibly for a sufficient period to be affected by insecticides with a residual action. Treatment with such materials may, therefore, be applicable to surfaces of sawn timber in which attempted egg-laying takes place.

Experience with other wood-boring insects, e.g. *Anobium, Lyctus,* shows that a proportion of these beetles can emerge unharmed, through surfaces treated with D.D.T. and benzene hexachloride; a smaller proportion is destroyed in the attempts to do so.

Mr. Hanson: Rawlings states that under laboratory conditions in New Zealand *Sirex* adults were found to be very resistant to the following insecticides, D.D.T., B.H.C., Toxaphene and Rothene, even when applied in concentrations far in excess of that which would have been possible in the field.

Other highly toxic insecticides such as E. 605 would doubtless be too dangerous for this purpose.

Trap stems might with advantage be used for the collection and destruction of any adult wood wasps which emerge from the timber while awaiting heat treatment. For this purpose fresh-felled pine poles should be cut into 6 feet lengths and stood on end to form tripods with the tops fastened together with wire. The tripods should be placed a few yards apart around the stacks of timber. The insects would be attracted to the fresh pine logs for oviposition, and could be collected by hand.

If facilities are available the timber might be submerged in water while awaiting further treatment.

Prof. Joly: It seems that for wood of lesser thickness, such as boards, spray treatments with pentachlorphenol are able to give the desired ends (on condition that the two faces are impregnated) in the destruction of larvae.

Destruction of the adult insects in the breeding stage with powders or sprays on stacks of timber does not seem to be able to be complete. Furthermore, the experience I have had with the "lophyres" insects, of the same family, has shown that one of the two insecticides D.D.T. or B.H.C. was rather ineffective.

Heat treatment is the most certain 100 per cent. destruction.

Prof. Vayssière: I do not think that in Europe any attention is given to disinfecting timber liable to be infested by *Sirex*. This is clearly very regrettable,, and I draw attention to it whenever I have the opportunity. Heat sterilization would give excellent results. I do not think that it would be the same with D.D.T., H.C.H. (B.H.C.), etc. Personally I advocate disinfection by toxic fumes (methyl bromide, ethylene oxide, hydrocyanic acid) used under partial vacuum, but I know that this advice is not followed, although we have at our disposal the appropriate installations at certain of our ports.

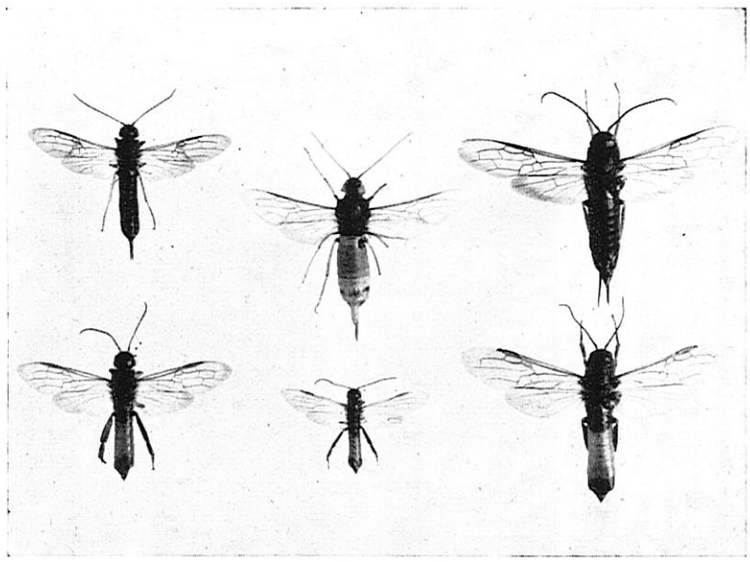
Dr. Becker: The treatment of large parcels of *Sirex*-infested timber can be done by heat-drying and kiln sterilization or the application of gases (for a sufficient time). Brushing, spraying or dipping with wood preservatives could also be used. In these cases the chemicals have to be of high efficiency and deep penetration like some preservative substances, developed in Germany for killing *Hylotrupes* larvae in infested wood. In the case of preservatives with less efficiency and penetration these should be treated by dipping for a longer time. Correct application of more effective chemicals would furnish a protection also against termites, other insects and wood-destroying fungi, and therefore allows the price of these treatments. All methods mentioned are relatively expensive. But there seem to be no cheaper ones.

Different natural enemies are known: woodpeckers and some parasitic Hymenoptera. The most effective of the latter seem to be *Rhyssa* species, which are introduced from Europe to New Zealand for natural control. *Ibalia* species seem also to be useful parasites for natural control; but this insect has a larger life cycle than *Rhyssa*. Other genera are *Thalessa, Ephialtes, Xylonomus, Xorites* and *Pteromalus*. In Germany natural enemies are not used. Good forest management and correct using of the felled wood are the best ways to check the Siricidae pests.

APPENDIX VI

ILLUSTRATIONS

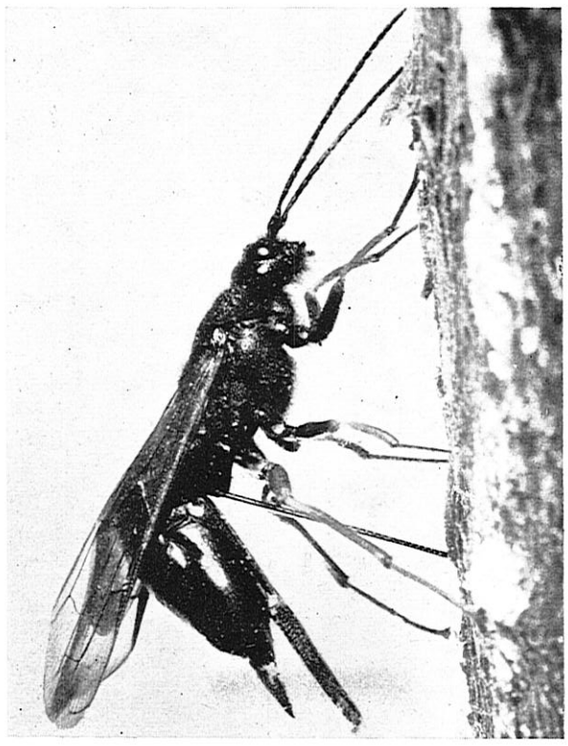
FIGURE 1



Adults of three species of wood wasps. Top row, from left to right, adult females of: *Sirex juvencus, Urocerus gigas* and *Sirex noctilio*. Bottom row, from left to right, adult males of: *Sirex juvencus,* the same but a smaller specimen, and *Sirex noctilio*. All about natural size.

(Photograph by courtesy of the University of Adelaide, Waite Agricultural Research Institute.)

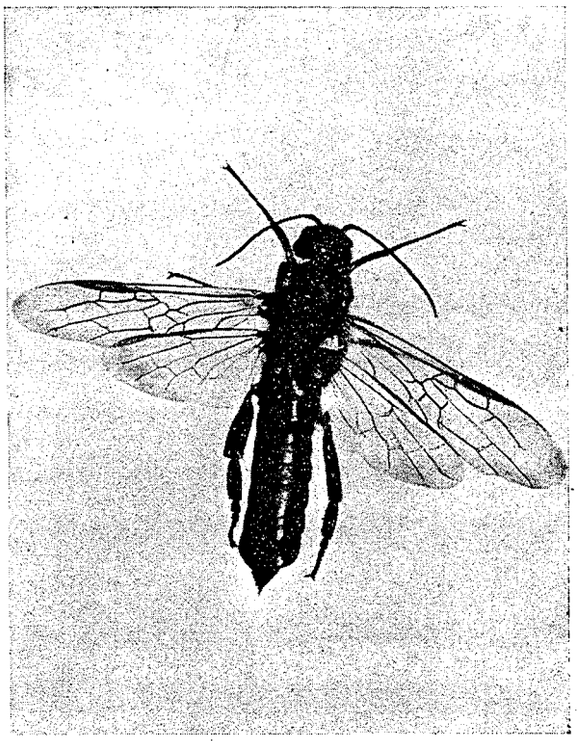
FIGURE 2



Adult female of *Sirex noctilio* ovipositing in a pine tree. Much enlarged.

(Photograph by courtesy of the Director, New Zealand Forest Service.)

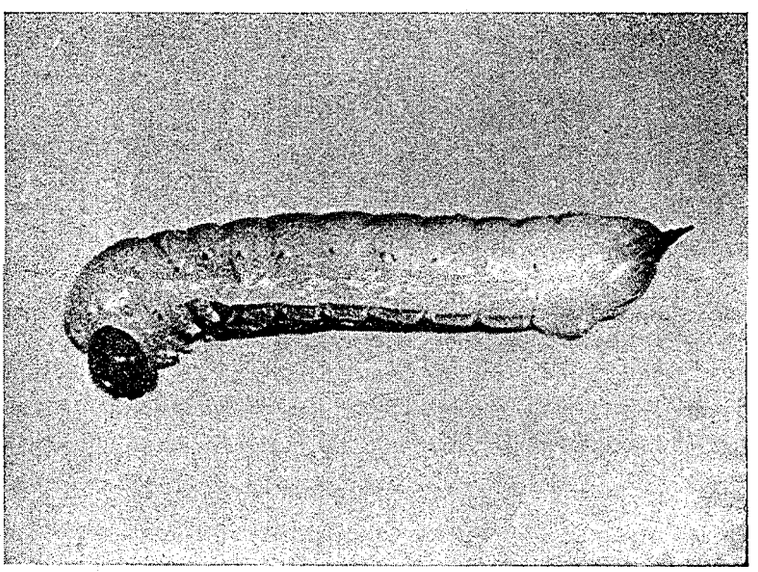
FIGURE 3



Adult male of *Sirex noctilio,* much enlarged.

(Photograph by courtesy of Mr. L. Miller, Chief Entomologist, Department of Agriculture, Tasmania.)

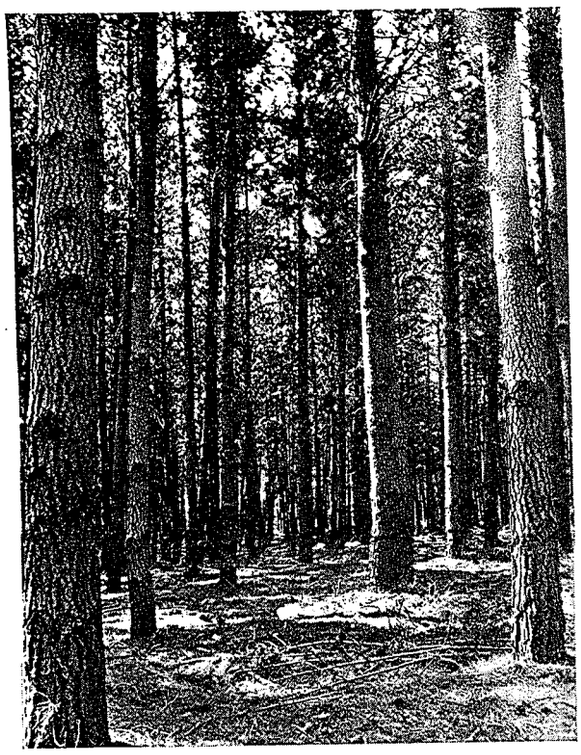
FIGURE 4



Mature larva of *Sirex noctilio,* much enlarged. Note the spine at the posterior end of the body.

(Photograph by courtesy of Mr. L. Miller, Chief Entomologist, Department of Agriculture, Tasmania.)

FIGURE 5



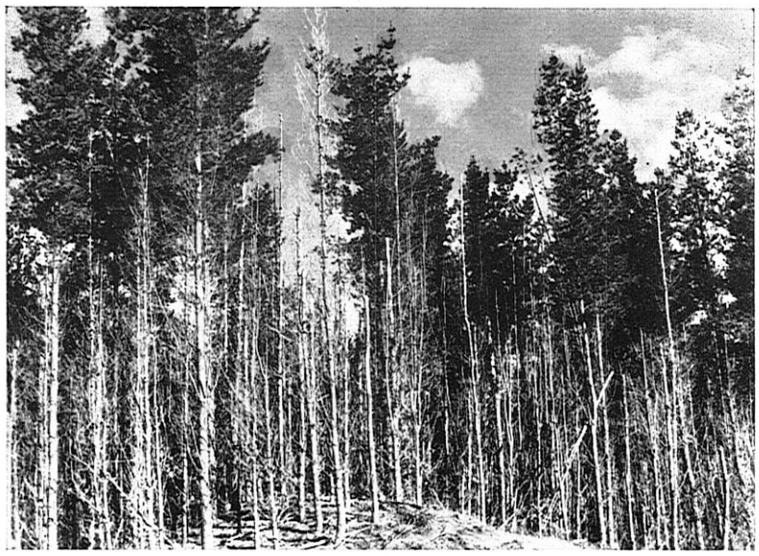
A valuable stand of *Pinus radiata* in the Mount Crawford Forest Reserve, South Australia. Trees planted 1920: 25 years old at time of photograph.

FIGURE 6

A plantation of *Pinus radiata* in the Rotorua district, New Zealand. After the dead *Sirex*-damaged trees were removed, less than 70 trees per acre were left.

(Photograph by courtesy of the Director, New Zealand Forest Service.)

FIGURE 7

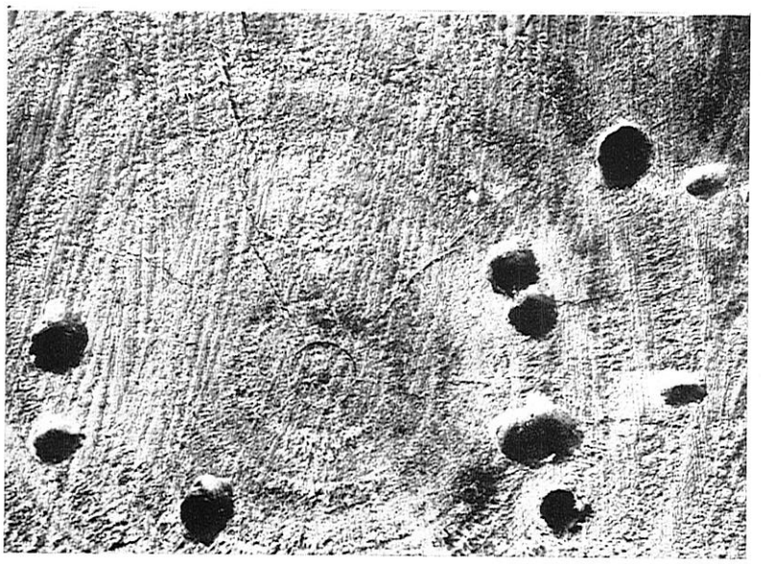


A plantation of *Pinus radiata* in the Rotorua district, New Zealand, showing a high proportion of trees that have been attacked by *Sirex*.
(*Photograph by courtesy of the Director, New Zealand Forest Service.*)

FIGURE 8

A group of *Pinus radiata* in the Rotorua district, New Zealand. Notice how the resin flows from recent oviposition punctures by *Sirex*.
Photograph by courtesy of the Director, New Zealand Forest Service.)

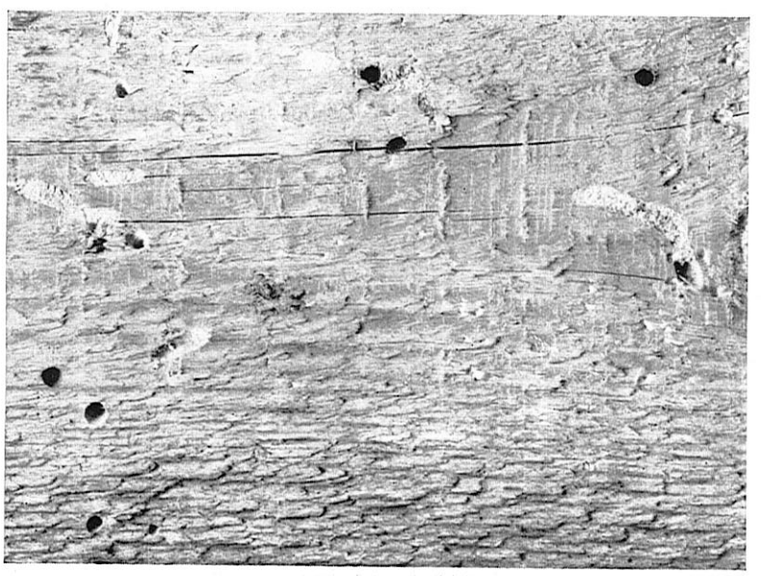
FIGURE 9



A log of *Pinus radiata* cut transversely to show the tunnels made by the larvae of *Sirex noctilio*. Enlarged.

(*Photograph by courtesy of Mr. L. Miller, Chief Entomologist, Department of Agriculture, Tasmania.*)

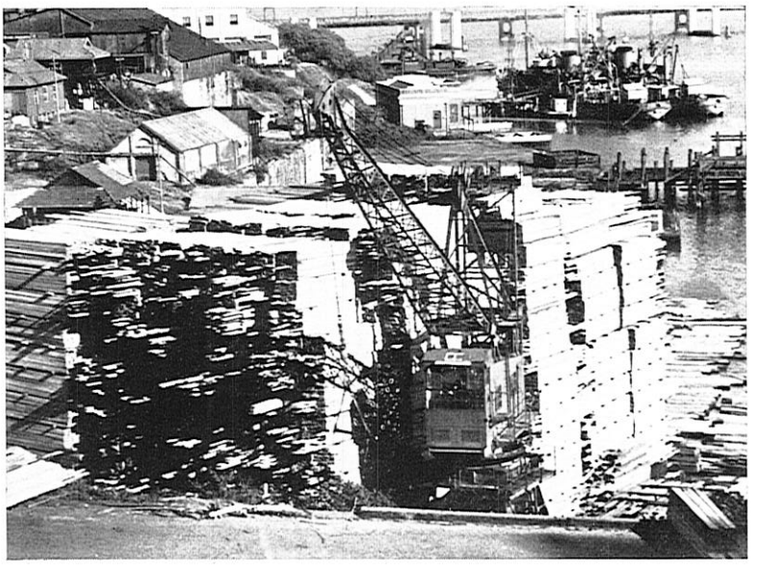
FIGURE 10



The surface of a piece of timber imported from Europe and intercepted in quarantine in Adelaide. Note that some tunnels have been cut obliquely. Specimens of *Sirex juvencus* were obtained from this timber. About natural size.

(*Photograph by courtesy of the University of Adelaide, Waite Agricultural Research Institute.*)

FIGURE 11



Stack of imported timber in Sydney. It is difficult to make a thorough inspection of large stacks of closely-stacked timber.

(Photograph by courtesy of the Director of Plant Quarantine, Canberra.)