the number of branches which produced flowers was expressed as a percentage of the sample of 200. The branches were all from the same level of the crowns and approximately the same age. The outbreak area was at Boom Creek, Banff National Park, and the non-outbreak area at Vermilion Crossing, Kootenay National Park. The results of the observations are presented in the following table.

Percentage of the branches supporting flower buds

—	Outbreak Area	Non-Outbreak Area
21-year average (1933-53) of fully developed buds	20·5	14·7
Buds formed in 1950	3·5	23·0
Buds completing development in 1951	0·0	14·7

—R. F. Shepherd.

Spruce Budworm in the Northwest Territories.—The spruce budworm was first reported from the Northwest Territories in 1947. V. L. Shattuck of the Department of Mines and Natural Resources submitted a collection containing empty pupal cases to the Forest Insect Laboratory, Winnipeg (Annual Report of the Forest Insect Survey 1947, p. 69). These pupal cases were collected early in June and were probably formed in 1946.

R. W. Reid in a report on a reconnaissance trip to the Northwest Territories in 1951 (unpublished report, Calgary Laboratory) reported seeing spruce budworm damage from the air along the Great Slave River north of Fort Smith. He also found evidence of endemic populations of spruce budworm along the shores of the East Arm of Great Slave Lake. He found larvae at Yellowknife and received reports of the presence of spruce budworm in spruce stands along the Mackenzie River.

In 1954, Warden R. C. Timmons of the Department of Northern Affairs and National Resources at Fort Norman submitted a collection containing empty pupal cases and feeding damage to the Forest Biology Laboratory, Calgary. He reported that a small area along the Mackenzie just north of Fort Norman had been defoliated.

In 1955, a reconnaissance along the Mackenzie River was conducted to determine the extent of the damage caused by the spruce budworm at Fort Norman and to find out if other infestations were present between Great Slave Lake and Fort Norman. The spruce budworm was present from a few miles above Fort Simpson to approximately 90 miles below Norman Wells, a distance of approximately 400 miles. Reports received from wardens of the Department of Northern Affairs and National Resources in 1955 indicate that this infestation extends about 40 miles up the Great Bear River, and that the spruce budworm is present along the Liard River near Fort Liard, N.W.T. The width of the infestation along the Mackenzie River could not be determined but was seen to extend about 15 miles up some of the river valleys entering the Mackenzie.

Intermittent heavy defoliation was present from a point 15 miles above the mouth of the North Nahani River to Norman Wells. The northern boundary of the infestation was observed by a Canadian Pacific Airlines pilot.

The degree of damage varied from light to severe. Although most of the feeding was confined to the new growth many of the trees in the severely infested areas were bare of foliage for several feet down from the top. Defoliation was most noticeable on spruce-covered islands in the River. The infestation was often very noticeable on one side of the River while little discoloration could be seen on the other. The heaviest infestation occurred in stands of pure white spruce; lighter infestations were found in mixed white spruce and poplar, and in white spruce and jack pine. Tamarack trees adjacent to heavily infested white spruce were also attacked. Balsam fir, the preferred host of the spruce budworm, is not found in the Mackenzie River Valley.

The spruce needleworm, *Dioryctria reniculella* Grt., and the black-headed budworm, *Acleris variana* (Fern.) were found associated with the spruce budworm in this infestation. At McGern Island (62° 45′ N 123° 10′ W) the spruce needleworm made up about 25 per cent of the population. Only a few black-headed budworm were found at any of the collection points. Parasitism of the spruce budworm was light. There was evidence of disease in the collections submitted but the specific organisms have not yet been determined.—C. E. Brown.

BRITISH COLUMBIA

Post-Attack Chemical Treatment for Ambrosia Beetles.—Methods of preventing ambrosia beetle damage to coastal softwoods by direct measures have hitherto been concentrated on the development of preventive chemical treatments intended to kill the attacking adult beetles before they could bore into logs or sapwood lumber. Since preventive treatments must be applied prior to the attack period, timing often limits the practicability of such treatments. It has been considered too difficult to kill the beetles once they enter the wood, but during the last two field seasons, attempts were made to develop a post-attack treatment. A fumigant poison, ethylene dibromide, was added to a stable emulsion preparation of a preventive residual toxicant. This formulation of 0·4 per cent lindane (gamma benzene hexachloride) has given adequate protection to logs that were moderately attacked, but has not given consistently high protection against heavy attacks (i.e. 100-200 attacks per square foot).

In the first of these experiments, 0·4 per cent ethylene dibromide was added to the residual toxicant, and the hemlock and Douglas fir blocks were not sprayed until seven days after they were initially attacked. Careful examination of these blocks showed almost no effect of the treatment, other than a slight reduction in the number of attacks subsequent to spraying.

During 1955, five Douglas fir blocks were sprayed one week after attacks commenced with an emulsion containing 0·4 per cent lindane and 5·0 per cent ethylene dibromide. At the time, adult beetles of the genus *Trypodendron* had bored radially about $\frac{1}{4}$ inch and tangentially from $\frac{1}{4}$ to $\frac{1}{2}$ inch. Total gallery length approximated $\frac{1}{2}$ to $\frac{3}{4}$ inch. Another five blocks were left untreated for checks.

Three days after spraying, numerous dead males were noted around the bases of the treated block. After three weeks it was obvious that boring dust had not been extruded from galleries in the treated blocks after spraying. Unsprayed blocks were covered with the white boring dust. One month after attack, two treated and two check blocks were examined; no living insects were found in the treated sections, and the number of holes showing on radially split faces was considerably less than in untreated blocks. Attack density was also less in the treated material. When the remainder of the blocks were examined it was found that damage in sprayed blocks averaged 26·6 entrance holes per square foot and 0·7 holes per 10 linear feet of radial face. The corresponding damage indices for the untreated blocks averaged 61·0 and 10·2 holes. The experiment demonstrated that the heavy dosage of ethylene dibromide arrested the development of beetles in the wood, while the lindane successfully prevented subsequent attacks.

Though the experiment was on a small scale, and should be repeated to confirm results obtained, the treatment holds promise as a practical method of reducing damage after the beetles have entered the wood. It may find application against beetle attacks in freshly sawn high-value lumber. Some discriminating export markets refuse lumber infested with beetles so that attacks in clear lumber grades in mill yards are often costly. The method may offer a practical alternative to preventing this type of beetle damage where kiln drying treatments cannot be arranged on short notice (*See* Hopping, G. R. and J. H. Jenkins. 1933. Canada Dept. Inter. Forest Serv. Circ. 38). It must be emphasized, however, that all sapwood faces of infested boards must be thoroughly wetted with spray which should be applied as soon as possible after the beetles have entered the wood.—J. M. Kinghorn.

Parasitism of Phytophthora spp. Isolated From Root Rots of Port Orford Cedar in British Columbia.—*Phytophthora lateralis* Tucker and Milbrath, *P. cinnamomi* Rands, and two unknown species of *Phytophthora* have been found in association with root rots of Port Orford cedar in British Columbia nurseries. *Phythophthora cinnamomi* has also been isolated from root rots of English yew and of rhododendron.

In Port Orford cedar, development of root rot is similar for each of the four species of *Phytophthora;* each enters small rootlets and progresses until main roots, and in many cases the stem, are girdled. *Phytophthora lateralis* frequently enters by an alternative infection court, i.e. cultivation wounds to very low branches. Losses in Port Orford cedar are heavy in nurseries contaminated with *P. lateralis* and light in nurseries with the other species. Inoculations of the stems of Port Orford cedar showed that, among the species tested, *P. lateralis* is most capable of infecting the stem and branches and of advancing in the bark (Table 1). This difference in pathogenicity to bark tissues might by itself explain much of the greater losses in Port Orford cedar from *P. lateralis* than from *P. cinnamomi* and the other species.

In English yew, root rot development is slower than in Port Orford cedar although the pathogen responsible is *P. cinnamomi*. Infection of yew in British Columbia has usually been limited to fibrous roots, resulting in yellowing of foliage. Damage from *P. cinnamomi* in British Columbia has been less than in Oregon from strains of the fungus investigated there. Inoculations of stems of yew resulted in failure to establish permanent infection after nine months for all species of *Phytophthora* tested (Table 1).

From the pattern of spread of disease in a nursery, into which stock infected with *P. lateralis* had been introduced, the following were inferred as the important, but not necessarily the only, means of spread: rapid dissemination of inoculum down the slope in surface water, slow dissemination across the slope in groundwater, and transport of soil particles by workmen. Up the slope, all infections had started as spot infections at a path always used by the workmen. Evidence of aerial dissemination was lacking, but it is assumed to take place by means of air-borne infected soil particles.

In British Columbia, the four *Phytophthora* spp. have been found only in ornamental nurseries and plantings. *P. cinnamomi,* however, is known to have been isolated from a wide range of hosts including species in all the coniferous genera, except *Tsuga,* that are represented in British Columbia forests. It has been proved by a number of investigators to be pathogenic under experimental conditions to Douglas fir. It can be inferred (Crandall, B. S., G. F. Gravatt, and M. M. Ryan. Root disease of *Castanea* species and some coniferous and broadleaf nursery stocks, caused by *Phytophthora cinnamomi.* Phytopath. 35: 162-180. 1945) that a wide dissemination of *P. cinnamomi* like that in the southeastern United States can occur within the 100 to 150 years that these authors suggest has elapsed since the supposed introduction of the fungus from Asia. No deductions can be made, however, as to whether *P. cinnamomi* could become established in natural stands of British Columbia until more information, including ecological data, has been obtained.—P. J. Salisbury.

Table 1
Results of Sampling Stem Inoculation With *Phytophthora* spp.

Species inoculated	Fungus used	No. of inoculations	Positive results (percentage): Definite cankers	Positive results (percentage): Temporary lesions	Average of maximum extension of lesions from point of inoculation after six months.
Chamaecyparis lawsoniana	*P. lateralis*	41	78	0	96 mm.
	P. cinnamomi	64	22	0	18 mm.
	Isolate CA	28	28	0	15 mm.
	Isolate Sy	8	0	25	< 5 mm.
Taxus baccata	*P. lateralis*	6	0	17	< 7 mm.
	P. cinnamomi	6	0	83	"
	Isolate CA	3	0	33	"

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O. H. M. S.

G. WESLEY BARTER, FI.
FOREST ZOOLOGY SECTION,
LAB. OF FOREST BIOLOGY,
COLLEGE HILL,
FREDERICTON, N.B.

SCIENCE SERVICE
DEPARTMENT OF AGRICULTURE
OTTAWA