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FAO/IUFRO Symposium on Internationally Dangerous Forest Diseases and Insects.—In 1957, a Working Group on International Cooperation in Forest Disease Research was formed by the International Union of Forestry Research Organizations (IUFRO) to promote world-wide cooperation in research and control of internationally dangerous forest diseases. This Working Group, under the chairmanship of Dr. J. R. Hansbrough, U.S. Forest Service, met for the first time during the 13th IUFRO Congress at Vienna in 1961 to review dangerous forest diseases of the North Temperate Zone. The proceedings of this meeting were published in 1963 (U.S.D.A. Misc. Publ. 939).

As a result of this meeting, the 13th IUFRO Congress recommended that FAO of the United Nations sponsor a broader symposium covering internationally dangerous forest diseases and insects. This recommendation was endorsed by FAO. Subsequently, a Symposium on Internationally Dangerous Forest Diseases and Insects was held at Oxford University, July 20-29, 1964, under joint sponsorship of FAO and IUFRO in cooperation with the British Forestry Commission and the Commonwealth Forestry Institute. About 135 participants were present representing 32 countries and international organizations including the Commission Internationalle de la Lutte Biologique, Commonwealth Institute of Biological Control, Commonwealth Institute of Entomology, East African Common Service Organization, European and Mediterranean Plant Protection Organization, and the World Meteorological Organization.

The symposium reviewed forest disease and insect conditions by geographic region; problems in control methods and procedures; the spread, appraisal, and prediction of hazards; the effectiveness of quarantine measures; and opportunities for increased international cooperation to lessen or prevent the spread of dangerous forest pathogens and insects.

The symposium created a new awareness of the magnitude of losses caused by diseases and insects in forests throughout the world and gave the participants an appreciation of the importance and urgent need for increased international collaboration. The recommendations of this symposium and the many excellent papers presented are to be published by FAO. A future issue of *Unsylva* will be devoted to a summation of the proceedings.—V. J. Nordin.

ATLANTIC PROVINCES

A New Nuclear Polyhedrosis of the Winter Moth, Operophtera brumata L.—Winter moth populations in Nova Scotia have been examined each year since 1955 for naturally occurring diseases. No cases of polyhedroses were found in over 1,100 larvae examined before 1961. In 1961, however, a single winter moth larva collected by the Forest Insect and Disease Survey from Hebron in Yarmouth County, N.S., was found to have died from a polyhedrosis. Since that time the number of specimens with polyhedroses has increased substantially each year and the disease has now been recorded from 13 areas in seven counties.

On the basis of the tissues attacked (i.e., blood cells, fat body, tracheal matrix, and epidermis) and because polyhedra are found only in the nuclei of the cells, this virosis appears to be a typical nuclear polyhedrosis of lepidopterous larvae. As yet it has not been described.

For several years, the Bruce spanworm, *Operophtera bruceata* (Hulst), a closely related indigenous species, has been known to harbour a nuclear polyhedrosis and the virus has recently been described (Smirnoff, W. A. J. Insect Pathol. 6: 384-386. 1964). It was at first suspected that the nuclear polyhedrosis in the winter moth and the spanworm were caused by the same virus. This possibility was suggested because the polyhedrosis in the winter moth was discovered at the same time that populations of the spanworm began to increase from endemic to outbreak levels and because diseased spanworm larvae were collected from areas where the winter moth was present. Cross-infection tests using polyhedra from spanworm larvae collected from northern New Brunswick (well beyond the present range of the winter moth) and polyhedra from winter moth larvae collected in Nova Scotia were conducted in an attempt to resolve this question. Because some of the test larvae of both species were naturally infected the tests were not conclusive, but they did suggest that the winter moth and the spanworm are both more susceptible to polyhedra from their own species. Also, examination of the polyhedra from each species in the light microscope suggests that two viruses are involved. The polyhedra from the winter moth are distinctly squarish in outline while those from the spanworm are irregularly hexagonal. Examination of the polyhedra and virus particles of this apparently new virus in the electron microscope is planned. The results will be compared with descriptions of polyhedra and virus particles of the spanworm polyhedrosis.—M. M. Neilson.

QUEBEC

Discovery of the Balsam Woolly Aphid, Adelgas piceae (Ratz.), on the Magdalen Islands.—The archipelago of the Magdalens in the Gulf of St. Lawrence consists of some fifteen islands lying approximately 70 miles northeast of Prince Edward Island. Most of the area of the main islands, which covers some 140 square miles, has been cleared for farming; somewhat less than 20% remains forested. Balsam fir is the most important tree species present, the only other species found in any number being white and black spruce. The forested areas are very important because they act as windbreaks in a region of almost constant high winds.

A branch sample of balsam fir collected on the Magdalens in 1964 and submitted to the Quebec laboratory showed signs of damage by the balsam woolly aphid. The diagnosis was later confirmed by officers at the Fredericton Laboratory and the collection represents the first record of the insect in Quebec. A survey of the Magdalens was carried out at the end of August to determine the status of the aphid on the Islands.

All balsam fir stands were found to be attacked by the aphid and adults of the insect were actively laying eggs. Injury to twigs, commonly referred to as "gout", was prevalent throughout the main islands. Many of the trees showed the pronounced taper and "gouty" top characteristic of trees infested by this insect. No stem-attack, usually associated with new infestations, was observed. Scattered dead trees, presumably killed by the aphid, were seen in many stands and were most common on Havre Aubert, the southernmost island of the Archipelago. In a fairly extensive young stand on this island, close to 25% of the trees were dead. Increment cores and discs obtained from a number of trees in various localities revealed the presence of irregular rings of "rotholz" followed by successive years of growth suppression characteristic of attack by the insect. From growth patterns it was evident that the insect had been present in outbreak numbers on the Magdalens for at least 14 years.

This European insect has occurred in western Nova Scotia since before 1910 and has since spread to other parts of Nova Scotia, to New Brunswick, Prince Edward Island, and Newfoundland. The present studies indicate that the insect reached the Magdalens between 1940 and 1950. How the insect reached there is an interesting question. The young larva or "crawler" is very active and moves rapidly over the bark. During this period of wandering many young larvae are caught and carried by air currents. The distance they can be transported in this manner is unknown but it is possible that the insect was transported by winds to the Magdalens from infestation centres in Cape Breton or Prince Edward islands, both of which are approximately 70 miles away. There is, however, a more plausible way by which the aphid may have been introduced to the Magdalens. Some years ago, at the time that the insect is suspected of having made its first appearance on these islands, balsam fir logs were imported from Cape Breton and Prince Edward islands for processing into lumber by small portable mills. It would not be surprising if this operation was responsible for the introduction of the aphid and perhaps some of its predators to the Magdalens.

Three species of predators of the aphid were found and sent to R. C. Clark of the Federicton Laboratory for identification. One of these, *Leucopis americana* Mall., is a native Diptera. A second Diptera, probably also native, has not yet been identified. The third, *Leucopis obscura* Hal., is a species introduced to New Brunswick about 1933 and now found throughout the range of *A. piceae* in eastern North America. These, and other enemies of *A. piceae,* have been unsuccessful in controlling outbreaks in the Magdalens in the past and cannot be counted upon to do so in the future.

The balsam woolly aphid outbreak on the Magdalen Islands can be considered as having reached a chronic condition. Mortality and severe deformation of balsam fir trees can be expected to continue. Although the forest stands on the islands cannot supply the local requirements for lumber because of their small size and poor quality, they do provide for certain needs such as fuel wood and fence posts. Probably the most important function of any trees on the Islands is to provide the much needed windbreaks. The existing stands are not sufficiently numerous or extensive to furnish these requirements and tree mortality, as a result of the woolly aphid outbreak, poses a serious hazard. An active reforestation program designed to gradually replace or supplement the balsam fir by suitable species such as spruces appears to be warranted. —J. R. Blais.

ONTARIO

Effect of Insects on a Girdled White Pine Plantation.— Approximately 400 acres of abandoned farmland in what is now the Kirkwood Management Unit, Thessalon, Ontario, were planted to white pine, *Pinus strobus* L., in 1928 and 1929. The trees, planted about 1200 to the acre, are now 3 to 8 ins. d.b.h., and 20 to 25 ft. high, and were unpruned until recently. Lack of thinning and pruning produced a stand of bushy trees, many badly formed because of repeated attacks by the white pine weevil, *Pissodes strobi* (Peck). The Ontario Department of Lands and Forests started a program in 1961 to salvage some of the stand by thinning to release the better trees. Conventional thinning was too costly since the trees had to be pulled down after cutting and there was no market for the wood being removed. It was proposed, therefore, to girdle approximately 50% of the stems and leave them standing to die over the next 2 or 3 years. It was thought that the more gradual opening of the stand would also prevent the growth of *Ribes* spp. which otherwise might promote white pine blister rust.

Three blocks of approximately ¼-mile square were treated in the following manner in the winter of 1960-61. The trees were pruned to a height of 6 ft. since the thick branches blocked access to the trunks. Unwanted trees were then marked with paint, and girdled by cutting a frill around the trunk with an axe 3 to 4 ft. above the ground. In other respects, the operation deviated somewhat from the original plan. Only 30% of the trees were marked, with 25% actually treated. Also, the number of marked trees per row varied from 14 to 48, with fewer trees on the west half of the block. The girdling varied from deep cuts completely severing the bark and phloem layers, to shallow cuts not always encircling the trunk. In many of the latter type, the bark closed, the cuts filled with resin, and, after a time, it was difficult to see that they had been treated. During the following winter, the potentially better crop trees were selected, pruned to a height of 16 ft., and further released by cutting down a few of the surrounding trees.

The sudden provision of an abundance of breeding material could increase the numbers of bark beetles in the plantation, resulting in considerable mortality to the crop trees in succeeding years. It was decided to investigate this possibility before continuing the thinning operations, and 8 rows of trees, approximately a 10% sample, distributed over a 20-acre block were selected for study in May 1961. The girdled trees in each row were identified by numbered, metal tags, and changes in the colour of the foliage, and the occurrence of insects was noted periodically during the next 3 years, the final examination being made in October 1964.

Three per cent of the girdled trees died by the fall of 1961, increasing to 29, 43, and 48% by 1962, 1963, and 1964, respectively. The greatest mortality occurred in 1962 and 1963 when 27 and 20% of the girdled trees still alive in those years, died.

Evidently the pruned branches, and several trees that had been cut to remove double stems, as well as a number of trees that had died in 1960, were more attractive to bark beetles than the girdled trees. The slash on the periphery of the stand and the trees dying in 1960 were heavily attacked by *Pityogenes hopkinsi* Sw., less frequently by *Ips pini* (Say). Only 2% of the girdled trees were attacked by these two bark beetles in 1961. Two weevils, *Pissodes approximatus* Hopk. and *P. affinis* Randall, also attacked a few girdled trees in 1961. The main attack by bark beetles occurred in 1962 on 21% of the girdled trees, with the main species being *Hylurgops pinifex* (Fitch) and *Dendroctonus valens* Lec. at the root collar level; *I. pini, Orthotomicus caelatus* (Eichh.), and *Trypodendron lineatum* (Oliv.) in the thicker-barked portions of the main stem, and *P. hopkinsi,* which attacked the thin-barked areas from about breast height to the top of the trees. The latter was the most prevalent species in the plantation. Further attacks by the two weevils mentioned earlier, as well as a few attacks by a wood borer, *Monochamus scutellatus* Say, occurred. The same species of bark beetles continued attacks on girdled trees that showed signs of weakening up to 1964. However, during this time, no attacks occurred on healthy untreated trees, and not all the girdled trees were attacked.

There may be several reasons why the bark-beetle attacks on the treated blocks were so light. In the first place, the bark-beetle population in the area was low at the beginning of the operation. The nearest source of many *I. pini* was in a thinning operation nearly 2 miles distant. The girdling itself was ineffective in killing many of the trees quickly, and the slash from the initial pruning absorbed the first attacks. The subsequent thinning to release crop trees provided additional breeding material other than the girdled trees. A few girdled trees are still dying and will continue to provide breeding material for the present population of beetles. It was noted that several of the girdled trees had been broken off by the wind in 1964 at the point of girdling. These trees had been attacked by *I. pini* and *P. hopkinsi,* and trees breaking off in the future will continue to absorb a part of the beetle population. Finally, the density of the stand may have prevented the rapid penetration of the beetles beyond the periphery of each block. These factors prevent an accurate assessment of the role played by bark beetles in killing the trees. However, it seems that they contributed very little to the mortality figures in this instance. *P. hopkinsi,* the most common species, is normally regarded as a secondary invader, as are some of the other species. *I. pini* has been known to kill apparently healthy trees, but this species was of minor importance in this stand.

The success of this type of thinning operation should not be evaluated only in terms of the resulting insect damage or lack of it. While the method employed has not resulted in any unwanted tree mortality from insects, an increase in the intensity of thinning might accelerate the buildup of bark beetles more than was the case in this experiment. The danger to future crop trees would then require more careful study. In conjunction with the entomological studies, some assessment should be made of the response of the crop trees to the additional root and crown space provided. It should be possible through a series of experiments to determine the degree of thinning required to produce optimum growing response, and at the same time prevent, or at least keep within acceptable limits, the risk of losses from bark beetles. —J. B. Thomas.

An Additional Record of Acleris variana Fern. from Black Spruce Club Tops.—Appreciable numbers of the black-headed budworm (*Acleris variana* Fern.) were reared during studies of the lepidopterous complex in black spruce (*Picea mariana* (Mill.) B.S.P.) "club tops". The studies, conducted at Black Sturgeon Lake, Ontario, employed cages (2 x 2 x 3 ft.) in which club tops from several locales in the general area were held throughout the summer. With the tops properly pruned and a length of the bole projected through the cage floor into a pail of wet sand, the tops were maintained in good condition for the entire summer. Insect emergence in the cages was checked daily and the insects removed.

The data presented in Table 1 corroborate the findings of Prentice and Hildahl (Can. Dept. Agric. Ann. Rept. For Ins. and Dis. Surv. 1955: 74-75) and Wong *et al.* (Can. Entomol. 91: 543-548. 1959), who found the feeding of large numbers of the black-headed budworm reddening black spruce club tops in northern Manitoba and Saskatchewan from 1954 to 1956. The populations of the black-headed budworm at Black Sturgeon Lake were apparently not as extensive as those encountered in the Prairie Provinces but could form concentrated epicentres for the localized outbreaks common to this insect. There is also a trend to higher populations of this insect in the tops taken from upland sites (Table 1). Thus the expansion of these populations is enhanced for the few black spruce on the upland sites are closely associated with white spruce (*Picea glauca* (Moench) Voss) and balsam

TABLE 1

Black-headed budworm (*Acleris variana* Fern.) from black spruce club tops at Black Sturgeon Lake, Ontario. 1962–1964.

Year	No. of tops	Numbers of *A. variana* per top: Overall Ave.	Overall Range	Drained Areas Ave.	Drained Areas Range	Wet Areas Ave.	Wet Areas Range
1962	8	8.0	3–15	—		—	
1963	10	13.0	0–29	17	2–29	6	0–15
1964	10	32.0	13–59	36	13–59	25	13–37

fir (*Abies balsamea* (L.) Mill.), the major conifer components of the forest in the area and the preferred hosts of the black-headed budworm.

The emergence dates of the black-headed budworm from the club tops were from August 4 to September 3, July 27 to September 6, and August 1 to September 9 in 1962, 1963 and 1964 respectively. These are somewhat later than corresponding dates for material reared from white spruce and balsam fir, namely July 20 to August 26, 1962; July 19 to August 16, 1963; and July 7 to August 15, 1964. Further study will be necessary to determine if different strains of the black-headed budworm inhabit each of the three conifer species, although individuals reared from the black spruce club tops readily laid eggs on a shoot of balsam fir when confined in a small cage.—R. E. Fye.

ROCKY MOUNTAIN REGION

The Occurrence of Tuberculina maxima Rost. on Cronartium Rust Infected Trees in Alberta.—During the summer of 1964 surveys were carried out in southwestern Alberta to establish the distribution of *Cronartium comandrae* Peck on lodgepole pine. During these surveys a hyperparasite, the purple mold, *Tuberculina maxima* Rost. was collected in a number of locations. These were the first collections of this fungus on any tree species in Alberta, though it has long been known as a parasite of the white pine blister rust, *Cronartium ribicola* J. C. Fischer, on western white pine in British Columbia and adjacent areas of the United States. (Mielke, J. L., Phytopath. 23: 299-305. 1933.) (Hubert, E. E., Phytopath. 25: 253-261. 1935.)

Special attention was given to *Tuberculina maxima* because of its value as a biological agent in reducing the number of aeciospores available for infecting the alternate hosts, and for killing portions of the cankered bark. *T. maxima* was collected at 13 locations in Alberta between Robb on the timber reserve of North Western Pulp and Power Limited, Hinton, and near Beaver Mines in the Crowsnest Forest, and included a collection from the Porcupine Hills. *T. maxima* was found parasitic on *Cronartium comandrae* on lodgepole pine in eleven areas, but was notably absent from other locations of this rust. One collection of *T. maxima* on *C. comandrae* was made from a plantation of Scots pine near Beaver Mines. This was the first report of *C. comandrae* on Scots pine in Alberta. *T. maxima* was also found parasitic on *Peridermium stalactiforme* Arth. & Kern on lodgepole pine in three locations. So far *T. maxima* has not been found on *Cronartium ribicola* on limber pine nor on *Peridermium harknessii* Moore on lodgepole pine or Scots pine.

To obtain more information on the incidence of *Tuberculina maxima* on *Cronartium* rust infected trees some data were collected at two locations. At Altrude Creek in Banff National Park, *T. maxima* was found on 12 out of 112 *Peridermium stalactiforme* infected trees, and on three out of five *Cronartium comandrae* infected trees. In this stand, there was also a white aeciospore form, presumably a race of *P. stalactiforme*, though the spores differ in some characteristics from the normal orange aeciospores of *P. stalactiforme*. Two of the 22 trees having cankers with white aeciospores were infected by *T. maxima*. The other location was on the north slopes of The Wedge, south of Evans-Thomas Creek in the Bow River Forest. In a 25-year-old stand of lodgepole pine heavily infected by *P. stalactiforme* and *C. comandrae,* of 12 trees infected by *C. comandrae*, three had *T. maxima*. Further work is planned to establish the incidence and role of *T. maxima* on Cronartium rust infected trees. —J. M. Powell and W. Morf.

BRITISH COLUMBIA

Laboratory Observations of Oviposition by the Golden Buprestid, Buprestis aurulenta L.—Apparently normal adults of this species emerge from structures after spending many years in larval development (Smith: Can. Entomol. 94; 586-593. 1962). When confined in tubes with Douglas-fir foliage they survive for weeks. A series emerging during the winter 1960-61 inside a log house built in 1947 and fed foliage has been reported (Smith: Can. Entomol. 94: 672. 1962). In 1961-62 and again during 1962-63, series similarly derived and handled were obtained. Amongst the second and third series, having 14 and 15 years of prior larval development respectively, 11 females laid unfertilized eggs following varying periods of foliage feeding. Several of the females oviposited more than once, one laying a total of 178 eggs in six masses at intervals during a ten week period (Table 1). All egg masses were invested with a cream-colored translucent viscid secretion.

A minimum of 41 days (mean: 77.4 days) elapsed before the first oviposition. These long pre-oviposition periods suggest some inherent need, but probably of shorter duration in nature, for post-emergent gonadal maturation. The literature is without reference to examples.

Spencer (Proc. Ent. Soc. B.C. 60: 45-47. 1963) reports that he secured a number of adults from the interior of another log house. These were preserved shortly after their emergence. He dissected "nine of these and found that none had mature reproductive organs; in fact, both ovaries and testes were so small as to be barely discernible". He concluded that egg laying required a post-emergence maturation period.

Taken jointly, the above observations strongly support each other and lead to a view that field-emerged adults of both sexes probably require a period of feeding on foliage for maturation.

While the mass-oviposition noted may have been induced by confinement, the accompanying investing secretion was nevertheless abundant. Mass oviposition may therefore occur, at least occasionally, under natural conditions. Concentrated populations are not rare in infested wood. For example, a post section bore 18 emergence holes on 49 sq. in. of surface, 16 of them in an area of 35 sq. in. The initiating eggs may therefore have been laid en masse, or singly in a concentrated manner.

The foregoing further suggest the impossibility of reinfestation inside structures, because of the absence of tree foliage for feeding to promote egg maturation.—D. N. Smith.

TABLE I

The relation between developmental time and fecundity, pre- and post-oviposition life and adult longevity in *Buprestis aurulenta* L.

Developmental time	Number of ovipositions	Total eggs laid	Time from emergence to first oviposition (days)	Time from last oviposition to death (days)	Total adult life (days)
14 years	1	2	72	0	72
	2	3	66	54	127
	2	2	106	69	178
	1	1	75	43	118
	1	1	92	82	174
	1	40	61	62	123
	1	9	41	16	57
15 years	1	26	48	33	88
	1	30	129	0	129
	2	11	116	28	152
	6	178	46	17	133

Proportion of Old and Young Adults in an Overwintering Population of the Ambrosia Beetle, Trypodendron lineatum (Oliv.).—"Old" and "young" adults of the ambrosia beetle, *Trypodendron lineatum* (Oliv.), can be distinguished by the appearance of their internal organs (Proc. 10th Internat. Cong. Ent., 4: 375, 1956 (1958); Can. Dept. Agr., For. Biol. Div., Bi-Mon. Prog. Rpt. 11(6): 3, 1955). Old adults have gone through at least one brood establishment period; young adults have not yet made galleries in logs. The distinction between the two age groups is clearer in females which, therefore, are used for this purpose.

The proportion of old adults in samples of overwintering or spring-flying *Trypodendron* taken in different years has varied from 1% to more than 30%. This wide range suggests that the proportion might provide important information about a population, if the factors that determine age ratio were known.

One obvious factor that may influence the young/old adult ratio is the productivity of beetles—the average size of brood produced from a certain breeding site. If only a few offspring are produced per pair of adults, a higher proportion of old beetles might be expected in an over-wintering population than if many offspring per pair were produced. Possibly, then, by determining the age ratio in these populations one could learn something about brood success in adjacent breeding areas that year (Can. Entomol. 93: 746, 1961).

The first step in examining this possibility was to determine whether all samples of beetles from one margin showed essentially the same ratio; i.e., whether the overwintering population was homogeneous in this respect.

On two dates during the overwintering period of the beetles, a series of bark and litter samples were taken, near Lake Cowichan, B.C., at the base of each of several trees. All trees were within a zone of standing timber approximately 50 by 150 meters, adjacent to a recently logged area. Many or all females in the samples were examined and the resulting data on their age subjected to the Chi-square test for homogeneity. Several samples with smaller numbers of beetles were combined in pairs to secure an expected number of five or more old adults for each sample. The data are given in the table.

TABLE 1

Number of old females in samples of bark or litter collected on two dates within a single timber margin.

Type of sample	Number of females	Number old	Type of sample	Number of females	Number old
Bark I (Jan. 7)	100	7	Litter I (Jan. 7)	37	2
	90	3		56	7
	76	6		79	9
	89	12		77	15
	101	7		67	11
	80	1			
	100	8		316	44
	636	44	Litter II (Apr. 24)	42	3
				38	3
Bark II (Apr. 24)	81	5		55	16
	75	9		42	5
	97	6		55	9
	65	5		42	8
	105	10		37	10
	78	6		36	3
				43	12
	501	41		47	5
				46	5
				45	7
				56	2
				584	88

Chi-squares, calculated for each of the four groups of samples, using the summed figures for each category to determine expected values within that category, indicated that Bark II and Litter I samples were homogeneous, Bark I doubtful and Litter II heterogeneous with respect to young/old adult ratio. However, because both collection dates fell within the period of beetle quiescence, we concluded that the two bark and two litter samples, respectively, could be pooled. This was done and yielded a Chi-square of 14.725 (19.68 for $P = 0.05$) for bark, and 36.144 (26.30) for litter. From these figures we may conclude that the bark samples were homogeneous for age ratio but the litter samples were not ($P < 0.003$). When combined bark samples were compared with combined litter samples, a Chi-square was obtained (24.533 $DF = 2$) for which the probability was less than 0.00003, so the bark samples clearly differed from the litter samples in proportion of old adults.

Our original expectation was that the proportion of old adults would be the same throughout the timber zone sampled, regardless of whether beetles were taken from bark or litter. This was based on the assumptions, (1) that old and young adults would behave alike as they entered the margin and selected overwintering locations, and (2) that they would all come from a breeding site that had a characteristic average beetle productivity. The fact that the samples studied were not homogeneous with respect to adult age means that at least one of our assumptions was wrong. It means, moreover, that more intensive sampling will be needed before trying to compare different margins or different years with respect to adult age ratio.

We thank Dr. E. C. Pielou, Statistical Research Service, Dept. of Forestry, for assistance.—J. A. Chapman and W. W. Nijholt.

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O. H. M. S.

DOUGLAS C. EIDT,
FOREST ENT. & PATH LAB.,
CANADA DEPT. OF FORESTRY, (3-6)
COLLEGE HILL, L-205
FREDERICTON, N.B.

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New Regional Forest Research Laboratory Opened in B.C.—The Department of Forestry's newest regional research establishment located on a 22-acre site at 506 West Burnside Road, Victoria, will serve as the centre for the Department's forest research program in British Columbia. Occupation of the building began early in January with the move of previously separated research units of the Department from their Government Street locations in downtown Victoria. The new laboratory, erected at a cost of $2,500,000, was opened ceremonially by the Hon. George R. Pearkes, Lieutenant-Governor of British Columbia, at 2:00 p.m., Monday, February 15. During the opening week some 4,000 interested persons visited the laboratory.

A 265-foot main building with three stories, a full basement, and a service penthouse, contains the most modern of laboratory facilities and the research offices. Abutting the research wing at the front is the two-storey administration wing which serves as administrative headquarters for the Department's wide range of activities on the West Coast.

An illustrated brochure giving a full description of the laboratory and an account of its activities has been prepared and copies may be obtained from the Public Information Section, Department of Forestry, Ottawa, or the undersigned.—W. A. Edwards, Public Information Officer, Forest Research Laboratory, Victoria, B.C.

ATLANTIC PROVINCES

An Unusual Increase of Spruce Sawfly Numbers in New Brunswick.—Since the end of the spruce sawfly outbreak in New Brunswick in 1940, populations of this insect have until recently remained at very low levels. On sample plots populations have fluctuated at levels less than 0.5 larvae per tree sample. The termination of the outbreak has been attributed to the introduction of a polyhedrosis virus and the subsequent regulation of the host at endemic levels to the effects of introduced parasites as well as the virus. This parasite-disease complex seemed so effective that it has been speculated that the European spruce sawfly would not again become a pest of economic importance in the forseeable future (Neilson, M. M., and Morris, R. F. Can. Entomol. 96: 773-784. 1964).

Beginning in 1960 two study plots at the Acadia Forest Experiment Station, in which population levels have been measured annually since 1937, were included in the area sprayed with DDT for control of the spruce budworm. Both plots were sprayed in three consecutive years, 1960, 1961, and 1962. Densities of the sawfly during these 3 years were reduced to the lowest levels ever recorded in the 28 years that populations have been sampled; only one larva was collected from 360 trees sampled during 1961 and 1962. Obviously the incidence of parasitism and disease could not be assessed.

In the first generation after cessation of spraying (first generation of 1963) sawfly densities increased on both plots and by the second generation of 1964 reached a level of more than thirteen times that of pre-spray years. Parasitised larvae were not collected until the second generation after spraying. The incidence of parasitism has, however, increased in each of the three subsequent generations, but has yet to reach the levels characteristic of the pre-spray years. No diseased larvae have been collected from either plot since the second generation of 1960 and it is possible that the virus may have been eliminated from the area.

This unusual increase in sawfly numbers is probably not confined to the Acadia Forest Experiment Station but may have occurred in other areas of New Brunswick with similar DDT spray histories. Forest Insect and Disease Survey sampling records for the spruce sawfly do not reveal such increases but this is probably due to the small size and the timing of samples. However, on Grand Manan Island where intensive sampling has been conducted for several years and where no aerial spraying has occurred, there was no indication of a concurrent increase in the density of the sawfly.

Aerial spraying against the spruce budworm apparently severely disrupted the balance that had developed between the spruce sawfly and its enemies. The rapid increase in host numbers is undoubtedly primarily due to the relaxation of the two most important regulating factors, parasites and disease. Spruce sawfly populations at Acadia are rapidly approaching 1938 levels and if the present trend continues defoliation of spruce will be noticeable in 1965. This population will be followed to see if parasites alone or in combination with disease will be capable of once again reducing sawfly numbers to the low levels characteristic of the pre-spray years, 1940 to 1960.—M. M. Neilson and D. E. Elgee.

QUEBEC

Notes on Ants Associated with Neodiprion swainei Midd. in Jack-Pine Stands in Quebec.—The following notes were gathered between May and September of 1963 during studies on ants (Formicidae) in stands of jack pine, *Pinus banksiana* Lamb., near Lac McLean, elevation 1,400 feet, Laviolette County, Que. The studies form part of a program of investigations on population dynamics of the Swaine jack-pine sawfly, *Neodiprion swainei* Midd. The aim was to determine the complex of ant species present in jack pine stands, and to provide a preliminary assessment of their effectiveness as predators on various stages of *N. swainei*.

The notes presented here result mainly from observations conducted in two rectangular 1 × 2 chain sample plots. Plot I was established in a 20-year-old jack pine stand, averaging 12 feet in height and with a mean density of 560 trees per acre. The ground cover consisted mainly of the moss, *Cladonia rangiferina* (L.) Web.; scattered clumps of *Kalmia angustifolia* (L.) and *Vaccinium* sp.; and occasional patches of *Politrichum commune* L. The organic layer was very thin and the soil sandy. Plot II was established approximately 500 feet from Plot I in an older jack pine stand averaging 40 years in age, 30 feet in height, and with a mean density of 1,970 trees per acre. The principal ground vegetation here was the same as in Plot I, but in addition, patches of *Calliergon schreberi* (Willd.) were present near decaying stems and stumps beneath the litter, as well as the occasional clump of *Epigea repens* L., *Gaultheria procumbens* L., and *Dicranum undulatum* Ehrh. The organic layer averaged about two inches thick over a sandy soil base. A number of decayed stems and stumps were scattered about the ground in both plots but were considerably more numerous in Plot II.

The complex of ant species in the plots was determined by a diligent search throughout the areas. The position of all nest entrances were located and permanently marked. Samples of ants from each nest were collected, killed, and mounted, and the identifications were kindly supplied by C. D. Miller, Entomology Research Institute, Department of Agriculture, Ottawa.

A total of ten species of ants were recovered (Table 1), the most common of which was *Formica fusca* L. This species was considerably more abundant in Plot I than in Plot II and the nests were most often located in exposed sandy locations; of the 51 nests of this species found, only three were built in decaying logs or stumps. Next in order of abundance was the minute yellow ant, *Lasiuns flavius* Wheeler, which was far more numerous in Plot II than in Plot I. Nests of this species were most often found in or directly beneath decaying logs or stumps. The nests of all the remaining species listed in Table 1, including four nests of the large carpenter ant, *Camponotus herculeanus* (L.), were restricted to decaying logs or stumps.

TABLE 1

Presence and relative abundance of various ant species recovered from two 1 x 2 chain rectangular sample plots near Lac McLaren, Laviolette County, Que.

Species	Number of nest entrances per plot		
	Plot I (open stand, small trees)	Plot II (dense stand, large trees)	Total
Formica fusca (L.)	40	11	51
Formica subnuda Emery	1	0	1
Formica sp. (*rufa* group)	1	0	1
Formica sp.	1	0	1
Camponotus herculeanus (L.)	1	3	4
Lasius flavius Wheeler	4	24	28
Tapinononia sessile (Say.)	1*	3	4
Myrmica brevinodis Emery	2	0	2
Myrmica lobicornis fracticornis Emery	1	0	1
Leptothorax muscorum (Nyld.)	0	2	2
Total	52	43	95

* 15′ outside the border of the plot.

As a result of direct observations conducted mainly in Plot I but also in other jack pine stands in the vicinity of the study area, four of the ten species were determined as predators on various stages of *N. swainei*. These were, *Formica fusca, camponotus herculeanus, Formica subnuda* and *Formica sp.* (*rufa* group). Of these, *F. fusca* appeared to be the most important predator. It exhibited a marked positive reaction to the presence of recently emerged *N. swainei* adults on the ground and was also observed carrying cocoons. In late June, approximately 200 recently emerged adults of *N. swainei,* and cocoons containing *N. swainei* adults near the point of emergence, were distributed on the ground within a radius of about 15 feet around a nest of *F. fusca* in Plot I. The ants reacted almost immediately to the presence of the sawfly; they were observed taking adult sawflies before they could fly and transporting them into the nest. In addition, the ants carried both sound and empty cocoons into the nest. During one-half hour following the dissemination of the material, a total of 22 adult *N. swainei* (8 + and 14 +), 12 sound cocoons, and 6 empty cocoons were dragged into the nest. Toward the end of this period, the ants were observed removing one of the empty cocoons and placing it a few inches from the nest. Observations were continued throughout the summer but not a single act of predation by *F. fusca* was observed on egg clusters or larval colonies of *N. swainei.* During this period *F. fusca* was commonly found foraging on jack pine but fed mainly on the secretions from aphids. On one occasion *F. fusca* was observed dragging a decapitated *N. swainei* eonymph on the ground, and it is possible that this ant reacts positively to the presence of pre-spinning eonymphs after they have dropped from the trees. These observations suggest that *F. fusca* may be important as a predator of *N. swainei* at two periods; in early summer when the adult sawflies are emerging, and during late summer or early fall when pre-spinning eonymphs are falling from the trees.

Of the remaining three species recorded as sawfly predators *Camponotus herculeanus* was observed on one occasion dragging an adult to its nest, and on two separate occasions, individuals of *C. herculeanus* were seen taking fourth- or fifth-instar larvae from trees in late August; *Formica subnuda* was observed taking an ovipositing female from a tree; and *Formica sp.* (*rufa* group) was seen dragging an adult *N. swainei* over the ground.

In view of the potential importance of these ants as predators on *N. swainei* studies will be pursued in greater detail in the coming season.—S. Ilnitzky and J. M. McLeod.

Note on Dicerca callosa Casey (Coleoptera: Buprestidae) in Canada.—In 1958, a number of male specimens of the genus *Dicerca* were collected by the author from a stand of trembling aspen (*Populus tremuloides* Michx.) near Laniel, Que. At first sight, these were thought to be *D. tenebrica* Kby. (= *prolongata* Lec.), but a close examination revealed some morphological characteristics which permitted their separation from *tenebrica.* Most noticeable amongst these characteristics is the absence of a tooth on the inner face of the mesotibia of the male, which tooth is well developed in *tenebrica.* Several similar specimens were found in the Lyman collection at Macdonald College, and in the National Entomology Collection of the Canadian Department of Agriculture, Ottawa. Part of our material was sent to G. H. Nelson (Loma Linda University, California) who is at present reviewing the genus *Dicerca,* and also to G. B. Vogt (U.S. National Museum, Washington, D.C.), another Buprestid beetle specialist. According to Nelson and Vogt, the specimens found near Laniel belong to the species *D. callosa* described by Casey in 1909. Unfortunately, Casey based the description of his species on a female specimen, and this sex does not offer as good morphological characteristics as the male (especially the tooth on the mesotibia), which would separate the species from *tenebrica.* For this reason, *callosa* was placed into synonymy with *tenebrica* until Nelson revalidated this species in 1963 (Coleopterists' Bull. 17 (3): 65-69). The species *callosa* Csy. has never been mentioned as part of the entomological fauna of Canada. At present, we have on hand specimens collected in the following localities of the Province of Quebec: Fabre, Shawbridge, Saint-Augustin, Cap Rouge, Ancienne Lorette, and Saint-Germain, as well as a few specimens from the following provinces: British Columbia, Saskatchewan, Manitoba, and Ontario.—Paul Benoit.

ONTARIO

Temperature Relationships of a Blight Attributed to Fusarium solani (Mart.) Sacc. on Trembling Aspen Suckers.—During experimental studies on the suckering response of trembling aspen (*Populus tremuloides* Michx.) to different temperature regimes and in darkness, it was observed that necrotic lesions developed on the leaves and stems of young suckers. Isolations from these lesions consistently yielded the fungus, *Fusarium solani* (Mart.) Sacc. (we are grateful to Dr. C. Booth, Kew, Surrey, and to Professor R. F. Cain, Department of Botany, University of Toronto, who identified the isolates of the suspected causal organism). This fungus has been reported to cause cankers in *Populus deltoides* Marsh. (Boyer, M.D. Can. J. Botany 39: 1195-1204, 1961).

Root cuttings 10 cm. long and 1.2 to 2.5 cm. thick were obtained from a 15-year-old stand of trembling aspen and grown in darkness in constant temperature, light-tight incubators. The root cuttings were placed in fine sand of 25% water-holding capacity (by weight) and pH 8.2. The soil moisture content was kept nearly constant at 20% by replacing evaporation losses with distilled water on alternate days. The relative humidity in the incubators ranged from 80% at 65°F. to 90% at 95°F.

The initial disease symptoms consisted of brownish-black necrotic spots at shoot apices and leaf margins. Later, similar but larger lesions appeared lower on the stems, and these caused shrivelling and finally death of the distal tissues. Root collar infestions invariably killed affected shoots. Killing of the tips seemed to stimulate development of two or more subjacent, but abnormal, lateral shoots with rosetting symptoms. Within 4 to 6 days of their initiation, one shoot usually became dominant, indicating an ability of very young aspen suckers to recover from this type of apical injury. A similar ability of 2-year-old suckers to recover from natural and artificial injuries inflicted during the dormant and growing seasons was noted in 1964.

The first symptoms of disease appeared at 87°F. 16 days after the experiment was started (Fig. 1). At 75°F. and 95°F. infections appeared simultaneously on the 22nd day (Fig. 1). The incidence of infection decreased progressively from the maximum of 88% at 87°F., to 68% at 75°F., to 35% at 95°F., and to zero per cent at 65°F. Etiolation of the suckers from growing in darkness may have increased their susceptibility to infection.

Infections occurred in shoots developed from cuttings grown both in sand and in a commercial soil conditioner, Perl-lome. It therefore appears that the fungus was introduced either on the root cuttings, or by aerial contamination. The latter is improbable because the incubators were sterilized with 50% Captan.

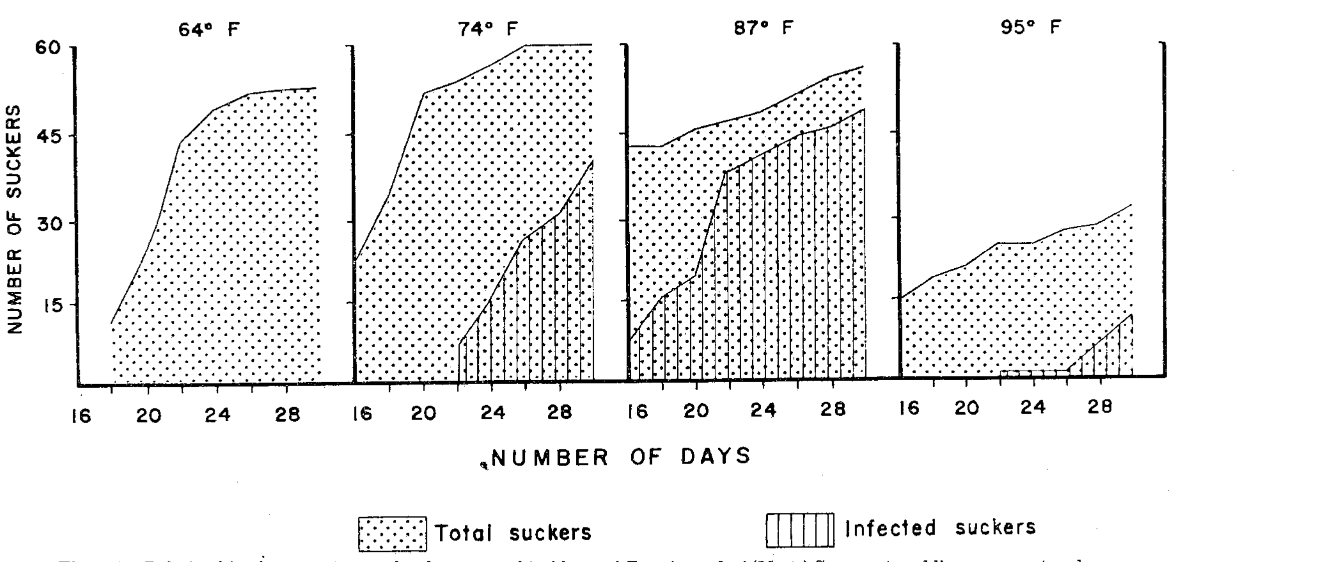

Figure 1. Relationship of temperature to development and incidence of *Fusarium solani* (Mart.) Sacc. on trembling aspen root suckers.

Under the conditions of the present study, the fungus appears to act as a parasite whose pathogenicity is closely related to temperature.—J. S. Maini and B. W. Dance.

Mortality in Artificial Populations of Spruce Budworm under Field Conditions.—The extremely low populations of the spruce budworm, *Choristoneura fumiferana* (Clem.), encountered in recent studies in the Black Sturgeon Lake area of Ontario (Fye R.E. Bi-Mon. Prog. Rept. 19(1): 2-3, 1963) have encouraged investigations of factors responsible for maintaining the populations at endemic levels. Eggs of the spruce budworm were introduced on seven white spruce and six balsam fir trees. The eggs were from female budworms reared from larvae collected in the collapsing localized outbreak at Plammes Lake in the Port Arthur District of Ontario. The study trees were 10 to 15 ft. in height and all competitive vegetation was removed. In July 1964, the trees were searched thoroughly and all spruce budworm and naturally occurring defoliating larvae of other species were removed from the trees and subsequently reared in the insectary.

The number of eggs introduced and the pertinent results are shown in Table 1. Additional data concerning eggs exposed in a similar manner in a 12 × 12 × 12 ft. cage covering a white spruce and a balsam fir tree are included for comparison.

TABLE 1

Results of exposure of introduced spruce budworms. Black Sturgeon Lake, Ontario, 1963–1964

Host tree	White Spruce	Balsam Fir	Total	Caged
No. of eggs exposed July 1963	641	479	1120	754
No. of late instar larvae removed July 1964	19	36	55	106
Per cent survival to late instars	3.0	7.5	4.9	14.1
Number of larvae parasitized	5	4	9	0
Per cent parasitized[1]	26.3	11.1	16.3	0
Number reaching adult stage	8	12	20	59
Per cent adults[1]	42.1	33.3	36.4	55.7

[1]Based on late instar larvae removed.

Inspection of the egg masses after an appropriate hatching period indicated that the number of sterile eggs in the introduced masses was negligible. One hundred and twenty-eight or 11.4% of the eggs exposed on the open trees were lost to predators. The total loss to predators was undoubtedly higher since occasionally whole masses were missing and could have been lost either to predators or through adverse weather. However, the inspection indicated that 856 or 78.1% of the eggs hatched.

Obviously, mortality is high in the young larvae since only 4.9% of the original egg population reached the late larval stage on the study trees. Some of the larvae were undoubtedly lost during the spring period of "ballooning" on finely spun threads (Rose, A. H. and Blais, J. R. Can. Entomol. 86: 174-177. 1954). However, in the cage where the ballooning was minimized by confinement of the larvae and some protection from the extreme winter weather and predation was afforded, the survival to the late larval instars was 14.1%. Also noteworthy is a higher survival to the adult stage of the late instar larvae in the cage. Since the eggs introduced into the cage were from the same female budworms as those exposed on the open trees, and presumed to have the same genetic qualities, we may speculate that the cage protected the larvae from undetermined environmental stress whose lethal effects were not manifested in the uncaged larvae until the late larval instars or pupal stage.

A higher survival was noted in larvae placed on the balsam fir trees than those on the white spruce. Unpublished data indicate that generally larger populations of predators inhabit the white spruce and these may appreciably reduce the populations of eggs and small larvae. That 95 of the 128 eggs known lost to predators were eliminated from white spruce and only 33 from balsam fir tends to corroborate this suggestion.

Parasites moved readily into the introduced populations of larval budworms also. The parasites reared included two specimens of *Exochus* sp. nr. *albifrons* Cr., two of *Apanteles*, n. sp. nr. *murinanae* C. and Z., four of *Elachertus cacoeciae* How. and one unidentifiable specimen. Further study will be necessary to determine the sources of these parasites but the extremely low level of the spruce budworm in the surrounding area suggests that alternate hosts and not the natural populations of the spruce budworm are the source.

Natural populations of *Acleris variana* Fern., *Zeiraphera* spp. and *Pulicalvaria piceaella* (Kft.) on the study trees harbored several parasites including *Scambus decorus* Wly., *Trathala* sp., *Diadegma* sp., *Meteorus pinifolii* Mason, *Apanteles californicus* Mues., and *Apanteles* n. sp. nr. *murinanae* C. and Z., of which *Scambus decorus* Wly., members of the genus *Diadegma*, and *Apanteles* n. sp. nr. *murinanae* C. and Z. are known parasites of the spruce budworm. However, only *Apanteles* n. sp. nr. *murinanae* C. and Z. attacked the artificially planted budworm populations.

Thus the early data from this study suggest that the progeny from the females of the endemic population of the spruce budworm are effectively suppressed by predation, parasitism, and other environmental factors and that a relaxation of one or more of these factors may permit population expansion to epidemic levels.

Grateful appreciation is expressed to the staff of the Canada Department of Agriculture, Entomology Research Institute, for the identification of the parasites obtained in this study, and to Mr. K. C. Hall, Forest Insect Laboratory, for supplying the material from which the eggs were collected.—R. E. Fye.

BRITISH COLUMBIA

The Balsam Woolly Aphid in British Columbia, 1964.—Population and tree mortality surveys of the balsam woolly aphid, *Adelges piceae* (Ratz.), initiated in 1959, and the predator release program, begun the following year, have been continued. Previous studies were presented in an earlier report (Silver *et al.* Bi-Mon. Prog. Rept. 18(3), 1962). The present report summarizes the results of the 1962, 1963, and 1964 work.

The known range of the balsam woolly aphid, in the southwest corner of the Province, has continued to increase each year since it was first discovered in 1958. On the mainland, it is present in valleys draining into Sechelt Inlet, Howe Sound, Burrard Inlet, and the Indian Arm and is probably responsible for heavy balsam mortality from Jervis Inlet eastward to Garibaldi Park and the Pitt River Valley. On southern Vancouver Island, several new infestations were discovered. In 1963, gouted *Abies* were discovered at a private home near Mt. Tolmie. In 1964, stem-attack was recorded just north of Victoria and at Mt. Douglas Park and the aphid was found on twig collections from Esquimalt Lagoon, and Mill Bay near Sidney. A considerable enlargement of the Thetis Lake Park infestation also became apparent. A 62 × 1 chain strip in the Park revealed 8 stem-attacked, 32 gouted, and 366 uninfested trees. Except for two infested ornamental *Abies* found in a garden at Duncan, the infestation is currently believed to be within an area of approximately 140 square miles eastward from a line drawn from Mill Bay south to Goldstream Park and southwest to Esquimalt Lagoon.

On the mainland, amabilis fir, *Abies amabilis* (Dougl.) Forb., is the principal host while on Vancouver Island, grand fir, *A. grandis* (Dougl.) Lindl. is the host most commonly attacked. The more susceptible amabilis fir occurs north of the present limits of the infestation on Vancouver Island.

Ten trend plots established in 1961 and 1962 in Howe Sound and Burrard Inlet drainages were re-examined in 1964 and results are summarized in Table 1. Plots at Cypress, Raffuse, and Brittania creeks were lost to logging. The number of gouted trees declined slightly on most plots and one to five more stem-attacks were noted on four plots. The death of between one and five trees on all but one plot, in which no mortality occurred, was attributed to aphid attack.

TABLE 1

Condition of amabilis fir on balsam woolly aphid study plots, 1961–1964.

Location of plot and area (in acres)		No. of stems						
		Healthy		Gouted		Stem-attacked		Killed by b.w. aphid
		1961	1964	1961	1964	1961	1964	1961–1964
Cypress Cr.	(0.6)	36	33	14	12	0	0	1
Grouse Mtn.	(1.2)	31	23	16	11	0	1	5
Rainy R.	(1.2)	46	35	14	13	0	0	2
Indian R.	(0.3)	37	24	0	13	13	15	0
Seymour R.	(0.3)	39	41	10	4	0	0	1
Seymour R.	(0.4)	46	36	3	7	1	6	2
Woodfibre Cr.	(0.4)	43	45	6	2	0	0	1
Dakota Cr.	(0.6)	48	45	2	1	0	0	1
McNair Cr.	(1.2)	8	9	13	9	0	0	5
Parkdale[1]	(2.4)	50	41	5	7	4	5	1

[1] First record in 1962, not 1961.

Five sample strips were run in the Vancouver North Shore and Sechelt areas where aphid damage was heavy (Table 2). The percentage of amabilis fir varied from 26.0 to 60.8. An average of 9.1% of the amabilis fir trees had been killed, 13.3% showed definite gout, and 5.2% had stem-attack. The heaviest mortality occurred on Mt. Seymour where 23% of the trees were killed and another 25% showed signs of stem-attack. Cypress Creek suffered the greatest volume loss because a large number of mature trees had died. Analysis of the data by diameter classes showed that stem-attack was most prevalent on pole-sized trees and gout was most severe on larger mature trees.

Annual aerial surveys in which red-topped tree tallies by drainages were made. There was an increase in the number of red-topped trees in 1962 and 1963. However, the numbers in the western half of the surveyed area decreased slightly in 1964; the eastern half of the area was not surveyed. Areas of heaviest tree mortality have been Ashlu Creek, Cypress Creek, Capilano River, Seymour Mountain, Mamquam River, Indian River, and Pitt River.

TABLE 2
The degree of attack in balsam woolly aphid sample strips, 1964

Location of strip	Total no. stems	% amabilis fir					
		In stand	Healthy	Stem-attacked	Gouted	Killed by b.w. aphid	Killed by other causes
Mt. Seymour	266	27.2	41.0	25.0	8.0	23.0	3.0
Lynn Creek	230	36.1	69.6	0.0	22.6	7.4	0.4
Cypress Creek	282	30.3	55.3	0.0	29.4	12.8	2.5
Mt. Elphinstone	441	60.8	97.3	0.0	1.5	0.5	0.7
Port Mellon	144	26.0	71.5	2.8	12.5	6.9	6.3

From 1959 to 1964, 55 balsam woolly aphid stem-attacked trees were examined to determine what insects and other organisms were associated with the aphid on the trunks of infested trees. A number of native predators were found, all of which occurred only occasionally. Two mites, *Allothrombium mitchelli* Davis and *Anystis* sp. were the most common predators on the mainland. Predaceous larvae of the syrphids *Metasyrphus aberranti* (Cn.), *Neocnemodon rita* (Cn.), and *Dasysrphus amalopis* (O. S.) were also found. At Thetis Lake the principal native predator was an undescribed species of *Leucopis*.

Another aphid, *Pineus abietinus* Underwood and Balch, was found at Kitimat and Smithers to the north beyond the balsam woolly aphid infestation but its significance is not known. A scolytid, *Pseudohylesinus grandis* Sw., attacked trees infested by the aphid at the Mt. Seymour study area but seldom attacked uninfested trees. Most of the heavily infested trees showed attack by *P. grandis* and bore fruiting bodies of *Dasyscyphus agassizii* (Berk and Curt.) Sacc., a fungus known to be saprophytic and indicative of areas of dead bark.

In 1962 and 1963 the following predators imported from Germany were released at Seymour Mountain: *Aphidecta obliterata* (L.)—2,800; *Aphidoletes thompsoni* Moehn—800; *Laricobius erichsonii* Rosenh.—4,900 *Pullus impexus* (Muls.)—1,400. No releases were made in 1964.

Only *L. erichsonii* was recovered after having overwintered. It is now established on the release site but has not dispersed more than 1 mile. Heavy feeding on aphids occurred where predators were present; the waxy "wool" on boles was loosened by the foraging of the larvae, and aphid populations had noticeably declined.

While the balsam woolly aphid is known to be well established in southwestern British Columbia around Vancouver, the extent of the infestation may be delineated more precisely as new methods of detecting its presence now being developed are introduced. Mortality of amabilis fir on the mainland has been heavy in some areas and aphid populations, based on numbers of stem-attacked trees, are not declining. All ages of *Abies* are susceptible. Mortality of grand fir on Vancouver Island has been negligible to date but may increase. The presence of the pest in nurseries near Victoria and on ornamentals in private gardens has demonstrated one method by which it is spread to other areas. One predator species has been established on the mainland but it is too soon to determine its effectiveness in reducing balsam woolly aphid populations.

Further predator releases and studies will be made. The survey program will be continued to point out areas where tree mortality is heavy and where it may be expected in the future. Such areas could be given priority in logging plans.—J. W. E. Harris.

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O. H. M. S.

DOUGLAS C. EIDT,
FOREST ENT. & PATH LAB.,
CANADA DEPT. OF FORESTRY, (3-6)
COLLEGE HILL, L-205
FREDERICTON, N.B.

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QUEBEC

Further Evidence of a Relationship Between Spruce Budworm and Evening Grosbeak Populations.—Recently, studies in a residual spruce budworm outbreak treated with DDT in the Rimouski River and Patapedia River watersheds in the Lower St. Lawrence region of Quebec indicated that evening grosbeaks (*Hesperiphona vespertina*) were attracted to the outbreak area in unusually large numbers, and that predation by these birds contributed to the collapse of the outbreak in 1962 (Blais, J. R. and G. H. Parks. Can. J. Zool. 42: 1017-1024, 1964). In 1963 and 1964, evening grosbeaks were exceedingly rare in the area formerly under budworm attack in Quebec. In 1964, the spruce budworm continued to occur in outbreak proportions in central New Brunswick, approximately 100 miles southeast of the outbreak area in Quebec referred to above. Part of the area in New Brunswick has been treated with DDT each year since 1960 in an effort to reduce damage to the trees (Macdonald, D. R. Bi-Mon. Prog. Rept. 20(1): 1-2. 1964). The junior author spent the first months of the summer of 1964 in the outbreak area and noticed that evening grosbeaks were present in great numbers. Large flocks of these birds could be seen in late May, June, and early July along bush roads. The birds in some flocks were so numerous that, on being frightened by passing vehicles, they seemed to hinder one another upon taking flight and it was difficult to avoid killing some of them while driving through this area. The proportion of the budworm population destroyed by the grosbeaks may not be significant at this time since insect numbers continue to maintain at a high level. However, should the insect population suffer a reduction through the action of natural control factors and/or through spraying, grosbeak predation, if continued, could contribute to bringing about the collapse of this residual outbreak as was the case recently in Quebec. The presence of spruce budworm in outbreak proportions appears to exert a considerable influence on the distribution of the evening grosbeak in eastern North America. It would be most interesting to determine the extent of this influence and whether the well known gregarious habit of this bird species is not conditioned, in part, by the presence of various forest insect outbreaks. —J. R. Blais and P. W. Price.

ONTARIO

Field Test with 2, 3, 6-trichlorophenyl Acetic Acid to Control.—Studies in the United States have shown that, under certain conditions, plant growth regulators can reduce the incidence of Dutch elm disease. Beckman (Phytopath. 46:605-609, 1958) demonstrated that 2, 3, 5, 6-tetrachlorobenzoic acid was effective when applied to bark, and Smalley (Phytopath. 52:1090-1091, 1962) found that 2,3,6-trichlorophenyl acetic acid* provided nearly complete protection when injected into the stems of elms (*Ulmus americana* L.) 12 to 15 ft. tall. These investigators found that, for the chemicals to be effective, treatment must be carried out in the interval between swelling of the buds and ¾ full-leaf. They considered it likely that the chemicals act by inhibiting spring wood development (Beckman, *op. cit.*), or by stimulating the development of tyloses in the large functional, spring vessels (Smalley, *op. cit.*), thus blocking the spread of infection. The current experiments in Ontario were timed to coincide with the leafing out of the trees, and were carried out using the sodium salt of 2,3,6-trichlorophenyl acetic acid. They were designed (1) to determine if the levels of control obtained in the United States held under field conditions in Ontario, and (2) to develop a gravity feed technique for injecting the active agent into trees.

Two methods for determining the effectiveness of the chemical were tested: injection of a weak solution into the boles of trees, and spraying a band of strong solution onto the barks of stems.

Injection test.—Experimental trees were selected on the basis of four criteria: (1) located in an area of zero, or low elm disease incidence, to help ensure that test trees were healthy prior to treatment; (2) with lower branches within 25 feet of the ground, to expedite inoculation; (3) in an even-aged stand and on a uniform site, to minimize experimental error; and (4) expendable, since all trees would be expected to die from artificially induced infections if the chemical proved ineffective. A stand fulfilling these requirements was located in Beverly Township, Lake Huron District. Here, 100 trees 2 to 5 inches d.b.h. were selected and segregated into pairs similar in diameter, height, form, and location. One tree in each pair was used as a control; the other was injected with the chemical. Inocula for initiating artificial infections were prepared from cultures of *Ceratocystis ulmi* (Buism.) C. Moreau, isolated on potato sucrose agar from disease samples collected throughout southern Ontario in 1963. If different pathogenic strains of *C. ulmi* exist in nature, this multiple origin of isolates would ensure exposing test trees to the maximum risk of infection. Two forms of inocula were used: a water suspension of 1-week-old conidia at a concentration of 4.3 x 10^6 spores per cc., and 3-week-old mycelia on agar. Between May 7 when buds were flushing and May 20 when leaves were nearing full development the trees selected for treatment were injected with 1 litre of 10 ppm of the chemical. The control trees were injected with 1 litre of distilled water. Equipment consisted of a 1-quart nalgene bottle with a spout moulded in the base, a 2½-foot length of tygon tubing, and a ⅜-inch, ridged, tapered tube connector. These were assembled into a water-tight system.

Using a 5/16-inch bit, a hole was drilled radially 1¼ inches into the stem of each test tree about 2 ft. above the ground. The tube connector was forced into the hole, and the assembly suspended above the point of injection to furnish hydrostatic pressure. After treatment the injection hole was sealed with wound dressing. The absorption period ranged from ½ to 26 hours, but averaged about 2 hours. This variation seemed to be related to weather conditions, crown size, and soil moisture. To determine if multiple injection points would distribute the chemical more uniformly and increase its effectiveness, a sub-test was conducted. In this test two holes were drilled, one on the opposite side of the stem from the other, in each of 30 pairs of trees. One-half litre of active agent or distilled water was injected into each hole.

Ten days after completion of the injection phase the trees were inoculated. This delay was designed to allow a period in which the trees could translocate the chemical and develop resistance. Each tree was inoculated at three points; on the stem at breast height, and on two small branches in different parts of the crown. Stem inoculations were made by removing a 1-inch square of bark, scraping the cambium, placing mycelia in agar against the exposed sapwood, and covering it with moist cotton and metal foil. Branch inoculations were performed by carving a channel through the bark into the sapwood on the upper surface. One cubic centimetre of spore suspension was washed into the wound. A pad of suspension-drenched cotton was applied and sealed with foil. Inoculated trees were identified with numbered tags and coloured markers.

To determine if the chemical had reached all parts of the crown, tests were carried out according to a method described (Ready and Grant, Bot. Gaz. 99:39-44, 1947.) for detecting the presence of plant growth regulators in water; the results were inconclusive. However, evidence that the chemical was distributed was secured by tracing the movement of dye in six test trees injected with a solution of the active agent and acid fuchsin. In most trees all leaves and the sapwood of branches and twigs became uniformly and deeply pigmented. It was assumed, therefore, that the active agent was similarly distributed.

Results.—On May 30, 1 week after the inoculation disease symptoms were observed in seven control and four treated trees; by June 17, numerous treated and control trees appeared diseased; and by late August most trees showed symptoms in varying degrees. To determine if the artificial inoculations had caused infections in all trees, samples from branches remote from inoculation sites were cultured. In several trees where the initial results were negative, re-sampling and re-culturing were carried out until

*Manufactured by the Hooker Chemical Co., Niagara Falls, N.Y.

the results were deemed unchangeable. These tests revealed that infections failed to occur in four treated trees and in two controls. To compare the condition of treated and control trees the following scale for rating the degree of crown injury was used: healthy, trace, light, medium, severe, and dead. The particular category selected for each tree was determined on the basis of (1) the percentage of foliage diseased, and (2) the percentage of twigs and branches killed. Since more control than treated trees remained disease-free, it can be concluded that the chemical failed to reduce the incidence of infection under the conditions of this study. Figure 1 depicts the crown condition in treated and control trees. The numbers on each curve show the number of trees in each classification.

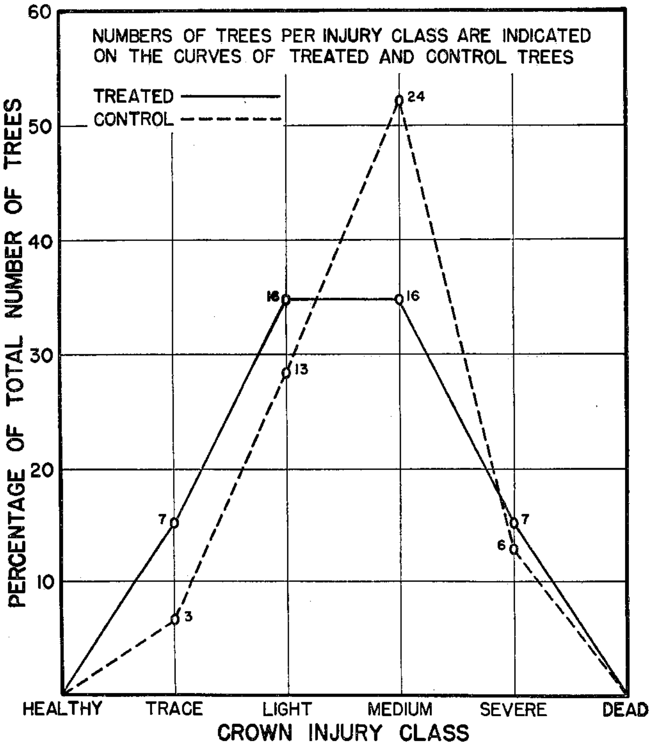

Fig. 1. Effect of 2,3,6-trichlorophenyl acetic acid on the degree of crown injury sustained in white elm trees affected by Dutch elm disease. Beverly Township, Lake Huron District 1964.

Other results were (1) the amount of crown injury sustained in treated trees was not related to the number of injection holes; and (2) the injection equipment proved efficient, simple to install, and leakproof in operation.

Bark Application.—Field trials were conducted in Culross Township, Lake Huron District, to test the efficacy of 2,3,6-trichlorophenyl acetic acid as a surface spray on stems. The experiment was based on two premises: (1) that the chemical would penetrate the bark and be systemically translocated by the sap stream; and (2) that infections would occur in healthy trees located in a stand with high incidence of elm disease. The sample consisted of 447 test trees and 480 controls in a pure, uneven-aged stand growing in a swamp. Stocking density and Dutch elm disease incidence were both high. All trees selected for the experiment were judged to be healthy on the basis of inspections during dormancy and after the leaves were fully developed. Spraying was carried out on May 4-5 when leaves were flushing. A solution of 18,000 ppm of the chemical was applied to the stems in a band at shoulder height. The width of the bond was related to tree diameter (Table 1).

TABLE 1

Relationship of band width to tree diameter

Tree Diameter (feet)	Band Width (feet)
1 or less	1
1 — 2	Diam. × 2
2 +	Diam. × 4

Results.—The condition of all trees was assessed on Oct. 6-7 by the rating system described for injection tests. Figure 2 depicts crown conditions of treated and control trees according to the percentage of crowns in different injury classes.

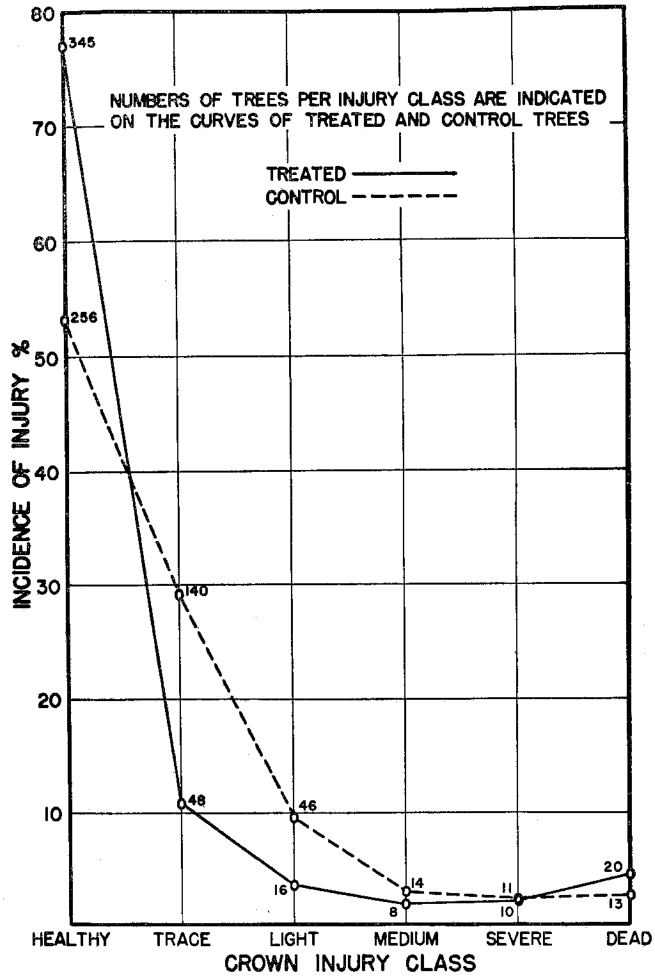

Fig. 2. Crown condition of elms treated with 2,3,6-trichlorophenyl acetic acid and of controls. Culross Township, Lake Huron District, 1964.

Conclusions.—If a significant number of treated trees survive, their future condition will be periodically re-appraised for evidence of residual resistance to natural infection.

In future tests an effort will be made to increase the effectiveness of the chemical by using stronger solutions (up to 50 ppm), and by lengthening the period between injection and inoculation to allow the tree more time to develop resistance.

No modifications to the inoculation and injection techniques are contemplated since each proved effective.—B. W. Dance, D. F. Lynn, L. J. Christie.

PRAIRIE PROVINCES

Some Observations on the Production of Staminate Flower by Jack Pine.—The importance of staminate flowers as feeding sites for jack-pine budworm larvae is well documented (Hodson, A. C. and Zehngraff, P. J., J. For. 44: 198-200, 1946) and information concerning flowering frequency is pertinent to the understanding of population fluctuations of this pest and the susceptibility of the host to attack. Some information on the incidence of staminate flower production was obtained from observations made in the Agassiz Forest Reserve, Manitoba in 1952 and from 1954 to 1959. The trees for which flowering records were kept were located in a relatively even-aged (40 years), lightly-stocked stand in close proximity to Provincial Highway No. 4, approximately 8.5 miles east of the town of Beausejour. During the period of observation, the stand was free from defoliation by the jack-pine budworm but infestations of moderate intensity had previously occurred during the late 1940's culminating in severe defoliation in 1951.

Two general crown forms were recognizable; orchard type, and tapering or normal type. There were 20 trees in the former category and 31 in the latter. In 1963, when the stand was re-examined and some of the trees felled, it was apparent that there had been some transition in form from the orchard to the normal crown type. This had not been evident during the period when flower records were being kept.

The trees were classified annually into three categories on the basis of staminate flower production: (1) Heavily staminate—trees bearing staminate flowers on all branches or with several branches heavily ladened with flowers; (2) Lightly staminate—trees bearing light male flower crops with flowers scattered over the tree or only two or three branches heavily ladened with flowers; (3) Non-staminate—trees with no or extremely few visible flowers.

In the autumn of 1963, several trees were felled for growth measurements. They were selected as representative of trees exhibiting different flowering patterns over the years of observation. Height and d.b.h. were measured and discs were cut 2 ft. above ground level. Widths of the annual growth rings of these discs were measured to the nearest 0.01 mm. under a binocular microscope using a filar micrometer. Measurements were made along three equally-spaced radii and averaged.

The proportion of trees in each flowering category in each year of observation is summarized in Table I. The year 1952 was only one in which some of the trees of both crown types did not bear heavy staminate flower crops. Flower production is known to be strongly inhibited in the year immediately following severe defoliation (Graham, S. A. Univ. Mich. School of For. and Cons. Bull. 6, 1935). This presumably accounts for the low incidence of flowering in that year. Although the orchard-type trees consistently bore heavier crops of flowers than the normal-crowned trees, the two types of trees exhibited the same general trends in incidence of flower production. Both had the highest flower production in 1957 followed by a sharp decline in 1958. The year 1957 was one of heavy pollen production by jack pine in southern Manitoba generally and localized severe outbreaks of the jack-pine budworm were widespread in the Province but none occurred in the vicinity of the study area. Whether the decline in flower production in 1958 was solely the result of adverse weather or a combination of weather and physiological changes induced by the previous year of heavy flowering is a matter of conjecture. Spring precipitation was below normal in 1958. High temperatures prevailed during most of April. At the end of the month there were severe frosts that caused considerable damage to developing buds.

TABLE I

Percentage of trees in each flowering category in each year of observation.

Year	Orchard type crown (N=20)			Normal type crown (N=31)		
	Flowering category			Flowering category		
	Heavy	Light	None	Heavy	Light	None
1952	0	35	65	0	18	82
1954	70	30	0	32	49	19
1955	70	30	0	29	39	32
1956	50	50	0	16	42	42
1957	85	15	0	58	29	13
1958	25	60	15	3	13	84
1959	45	55	0	26	48	26

The frequency of occurrence of the various flowering categories by trees of the two crown types over the 6-year period were analyzed to determine the general flowering pattern. Orchard-type trees were characterized by a predominance of heavy flowering and the absence of repetitive non-flowering. The normal-crowned trees were more variable in flowering behavior but exhibited a low frequency of heavy flower production and a greater incidence of non-flowering. Only two of the 51 trees failed to produce flowers during the period of observation.

Three groups of trees exhibiting different flowering histories were selected for growth measurements. Group I consisted of six orchard-type trees that produced heavy crops of flowers in all or most of the 6 years (mean height, 39.9 ft, mean d.b.h. 6.7 inches). Group II consisted of four normal-crowned trees that varied considerably from year to year in flower production (mean height 40.5 ft., mean d.b.h. 4.9 inches). Group III consisted of three normal-crowned trees that were primarily non-flowering or lightly-flowering (mean height 41.3 ft., mean d.b.h. 5.1 inches).

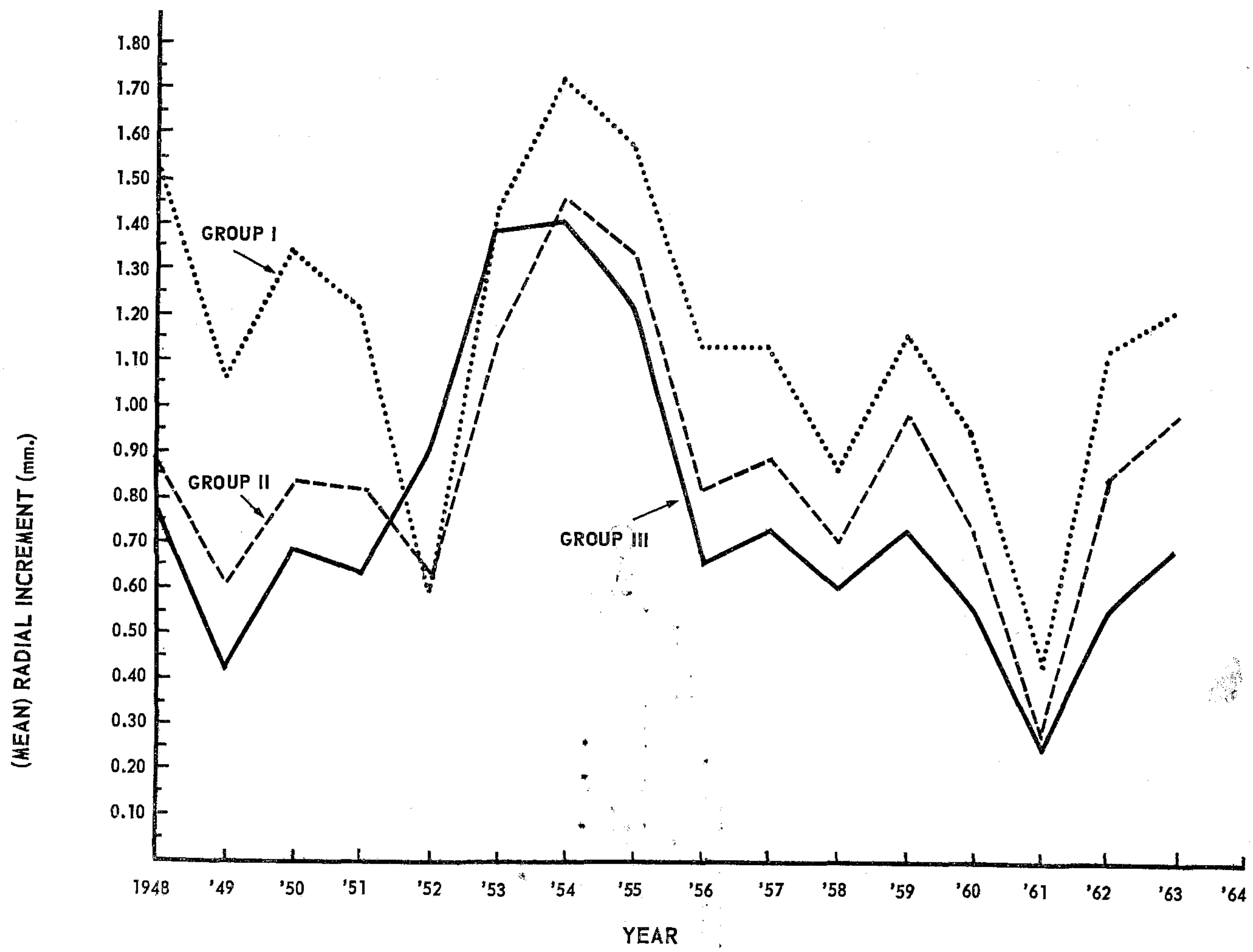

Fig. 1. Radial increment trends of trees with different flowering histories. GROUP I, heavy flowering; GROUP II, variable flowering; GROUP III, none or light flowering. Jack-pine budworm attacks occurred from 1948 to 1951.

The average radial increments for the trees in the three groups for the years 1949 to 1963 are plotted in Fig. 1. Despite the differences in flowering histories the growth patterns of the three groups of trees closely paralleled each other throughout most of this period. The only major differences were in 1952 when the trees in Groups I and II exhibited declines in radial increment from the previous year while the Group III trees did not. This decline in growth was particularly marked in the trees that had a history of repeated heavy flower production and is undoubtedly related to the severe defoliation by jack-pine budworm larvae that occurred in the area in 1951.

Two other years of sharply decreased increment growth, 1958 and 1961, were common to all groups of trees. These can both be attributed to climatic causes. As previously stated, 1958 was characterized by spring drought and frost damage. Severe drought occured throughout the spring and summer of 1961.

There was no evidence that flowering had any pronounced, direct effect on increment growth as the growth patterns of the flowering and non-flowering trees were both very similar, and both showed the same responses to sub-normal climatic conditions. Trees of the two crown types differed in staminate flower productivity and in susceptibility to jack-pine budworm feeding. This is apparent in the differences in increment exhibited by the two types of trees following a year of high budworm population. This dissimilarity in response could be of use in tracing the history of budworm outbreaks in a stand where the two crown forms coexist. However, it would be necessary to consider the possible transition in crown form of a tree during its development in response to closure or opening of the stand.—R. J. Heron and L. D. Nairn.

BRITISH COLUMBIA

Canker and Dieback of Douglas-fir in the Cariboo Region.—A severe canker and dieback of Douglas-fir was common in four widely separated areas of the Aspen-Lodgepole pine-Douglas-fir Parkland in the summer of 1964 in the Cariboo area. The effects were pronounced on saplings 1-4 inches d.b.h. The disease occurred in localized areas ranging in extent from several hundred yards to several miles. In one area extending for approximately 1½ miles along the roadside, an estimated 25% of the trees had been top-killed.

The bark in cankered areas of the trees becomes sunken and reddish. Attacked branches appear to die back to the trunk and form a canker at the base of the branch which frequently girdles the stem. The needles in the dead branches and leaders become reddened.

In all four areas where the disease was found, the lesions contained the fruiting structures of an undertermined species of *Dermea*. Mid-summer collections had only conidial fruiting bodies, but collections made in September had well-developed apothecia. Although a species of *Valsa* has been found in the distal, killed portions, the constant association of the *Dermea* fungus with the lesions indicates that it is responsible for the dieback conditions.

Observations also indicate that the disease has been active for at least 2 years; lesions in which the bark had become cracked and dried were present on some trees. The apothecia in the older lesions were still active. Some of the stems with older lesions appeared to have a greater number of internodal (lammas) shoots than healthy stems.

Because most of the attacked trees were vigorous and growing on good sites, predisposing factors of a climatic nature were indicated. Recently, early winter frosts of unusual severity have been reported from this region. These may be a factor in predisposition to the disease by damaging or killing the bark before it is hardened-off for the winter. The tissues may be made more susceptible to attack by weakly parasitic fungi to which the genus *Dermea* belongs.

The *Dermea* fungus has has been obtained in culture from ascospores and is being tested for pathogenicity in potted seedlings of Douglas-fir.—A. Funk, C. Cottrell, and T. Woods.

Rearing Cone Insects in the Laboratory on an Artificial Diet.—In 1964, three species of cone insects were reared on an artificial diet (McMorran, A. Can. Entomol. 97:58-62, 1965). More than 500 *Barbara colfaxiana* larvae were reared from hatching to pupation. Development on the diet was rapid. *B. colfaxiana* larvae require about 2 months to pupation under field conditions in cones, but on the diet some completed feeding in about 1 month and all had pupated in 6 weeks. Smaller numbers of *Laspeyresia youngana* and *L. piperana* were reared on the diet during the latter half of their larval development.

The freshly prepared medium was poured into small vials (about ½" in the bottom of 1-dram shell vials), or into Petri dishes and sliced into cubes for transfer to vials as required. Vials were plugged with non-absorbent cotton to reduce the chance of infection in the medium and to prevent insects from escaping.

Some of the important rearing difficulties overcome were.

1. Larvae were reared singly to prevent cannibalism.
2. The newly hatched larva were placed in a hole punched in the medium to facilitate feeding.
3. The vial was inverted when the insect was placed on medium. If the insect wandered it tended to move upwards, and this reduced the chances of entanglement in the cotton plug.
4. Vials were checked regularly for excessive moisture in feeding tunnels, mould, and drying and shrinking of the medium.
5. Moulting larvae were not removed from the medium as this may cause complications in shedding skin and head capsule.
6. Larvae were not allowed to spin pupal cocoons or to pupate in feeding tunnels in the medium. Mature larvae were provided with thin slices of medium, and cotton batting or loosened dental roll in which to pupate. *Laspeyresia* over-winters in the larval stage and does not present this problem.—A. F. Hedlin.

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CANADA

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QUEBEC

***Melanophila acuminata* DeGeer (Coleoptera:Buprestidae) in a One-year-old Burn in Quebec.**—In July 1963, fire destroyed approximately 16 square miles of forest in the Lake à la Carpe region, Pontiac County, P.Q. (lat. 46°45′, long. 76°45′). Components of the stand were white pine (*Pinus strobus* L.), red pine (*P. resinosa* Ait.), white spruce *Picea glauca* (Moench) Voss), eastern white cedar (*Thuja occidentalis* L.), balsam fir (*Abies balsamea* (L.) Mill.), and yellow birch (*Betula alleghaniensis* Britt.). One year later, at the end of June 1964, dead and dying trees were examined for insects.

Most of the insect material found was at the base of the trunks and under the ground on the main roots. All larvae were collected in the wood and were in their last instar; pupae and adults were found in the bark or in the wood. No buprestids were found on red pine, usually very attractive to *Chrysobothris dentipes* (Germar) and *Buprestis* spp.; only one species, *Melanophila acuminata* DeGeer, was recorded in the remaining host trees (Table I).

TABLE I

Summary of the occurrence of *M. acuminata* in 70 fire-injured trees at Lake à la Carpe, P.Q.

Host species	Number of trees		
	Examined	with galleries	with insects
Red pine	10	0	0
White pine	25	25	13
White spruce	8	6	4
Balsam fir	10	7	5
Eastern white cedar	15	10	6
Yellow birch	2	2	2
Totals	70	50	30

Pines, spruces, and balsam fir are known hosts of *M. acuminata* but this insect had not previously been recorded on eastern white cedar or yellow birch.—P.Benoit.

ONTARIO

A Leaf-mining Sawfly on Bur Oak.—In 1962, sawfly larvae of an unknown species were found mining the leaves of bur oak, *Quercus macrocarpa* Michx., in western Ontario. Adults from rearings of immature stages were subsequently identified as *Profenusa lucifex* (Ross) by H. E. Milliron, Entomology Research Institute, Ottawa. Reference to this species has not appeared in North American literature since H. H. Ross described a female specimen from Illinois in 1936. It would appear that the 1962 specimens constitute a first Canadian record of this leaf miner. No previous mention has been made of host tree or larval feeding habits.

In Ontario, *P. lucifex* has been found in the western forest districts of Kenora and Fort Frances on bur oak. The larvae feed in irregular, blotch mines on the upper surface of the leaves. The mined portion of the leaf turns pale brown with its bulged upper surface, somewhat transparent, revealing the cream coloured larva or larvae within the mine. On heavily infested trees as many as five mines, with one or two larvae in each, occur on a single leaf. The larvae complete their feeding in late July and early August and drop to the ground where they overwinter. Although the species was relatively abundant on some trees in 1962, only a few mined leaves were observed in subsequent years.—O. H. Lindquist and G. G. Jackson.

Nocturnal and Diurnal Fluctuations in Abundance of Some Predaceous Insects on Red Pine.—In 1962, diurnal fluctuations in the abundance of insects reported as predators of European pine shoot moth adults (Pointing, P. J. Can. Entomol. 93: 1098-1112. 1961) were studied, preliminary to further investigations of their effectiveness. The work was carried out in the Waterloo County Forest, near Elmira, Ontario. Thirty-six groups of four randomly selected trees, 4 to 6 ft. tall (and clear of adjacent trees), were sampled in a plantation of 1800 open grown red pine. Collections were made at 2-hr. intervals for periods of 8 hr. on clear type-days (Wellington, W. G. Ann. Rev. Entomol. 2: 143-162. 1957). Although all the 8-hr. periods were not consecutive, the equivalent of 3 days' records was obtained. Sampling was done by beating each tree vigorously with a pole and catching the dislodged insects on a tray, 6 ft. square, placed beneath the tree crown. Shielded air temperatures were recorded thermoelectrically immediately before and after each sampling.

The groups collected in this study were ants (Formicidae: *Formica, Myrmica,* and *Tapinoma*), three species of bugs (Nabidae:*Nabis subcoleoptratus* (Kirby); Reduviidae:*Sinea diadema* (Fabr.) and *Zelus sp.,* probably *audex* Banks), and one species of beetle (Carabidae: *Calathus gregarius* Dej.).

Ants of the subfamily Formicinae were 50 times as numerous as the other two species of the genera *Myrmica* and *Tapinoma.* The populations of Formicinae averaged 10.4 ants per tree, with a range of 0 to 62, and showed 2 peaks in activity at 0900 hr. and 1700 hr. (Fig. 1A). These peaks are similar to those described for *Formica subnitens* Creighton (Ayre, G. L. Insects Sociaux 5 (2): 147-157. 1958). Ants were much more active by day than by night.

Of the bugs collected, reduviids were found at all times of the day and night (Fig. 1c), while nabids appeared inconsistently in the samples (Fig. 1D). The latter phenomenon is probably due to the small sample.

The one species of beetle collected was the only species absent during the day and present during the night. The peak activity of this species on the trees occurred between 0100 and 0400 hr. (Fig. 1B). Carabids were the most active insects collected during the night. They ran rapidly across the tray even at temperatures as low as 4°C.

The data suggest some interesting interactions between these predators and the shoot moth. Shoot moth adults fly spontaneously between 1800 and 2100 hr., remaining quiet on the trees during daylight unless disturbed (Pointing, P. J. *loc. cit.*). Ants, being very numerous on the trees during the day, are probably the most common factor causing adult moths to take wing, where they become vulnerable to other predators such as asilid flies (Pointing, P. J. *loc. cit.*)

In the evening, mating and ovipositing moths are not as readily disturbed and could be easily caught by reduviids and nabids, which are on the trees during this period. Moths are also vulnerable just as they emerge from the pupal skin early in the morning, and a reduviid stalking a flightless moth has been observed.

Since shoot moths are inactive at temperatures below 12°C (Green, G. W. Can. Entomol. 94: 282-299. 1962), and carabids are active at 4°C, there is a temperature range of several degrees over which moths could not escape by flying and could be easily caught by carabids.

The study has indicated that sampling procedures should be modified to obtain representative collections of predators, since daytime sampling of trees would not include carabids, nor would night-time sampling include many ants. Consequently, in current studies of predation, utilizing the precipitin technique for determining the origin of gut contents, trees are sampled between 0500 and 0800 hr. to assure that collections of diurnally present predators are made as soon as practically possible after the evening period of likely predation. Pit-traps are used for the nocturnally present carabids, and are collected at the same time.—P. D. Syme.

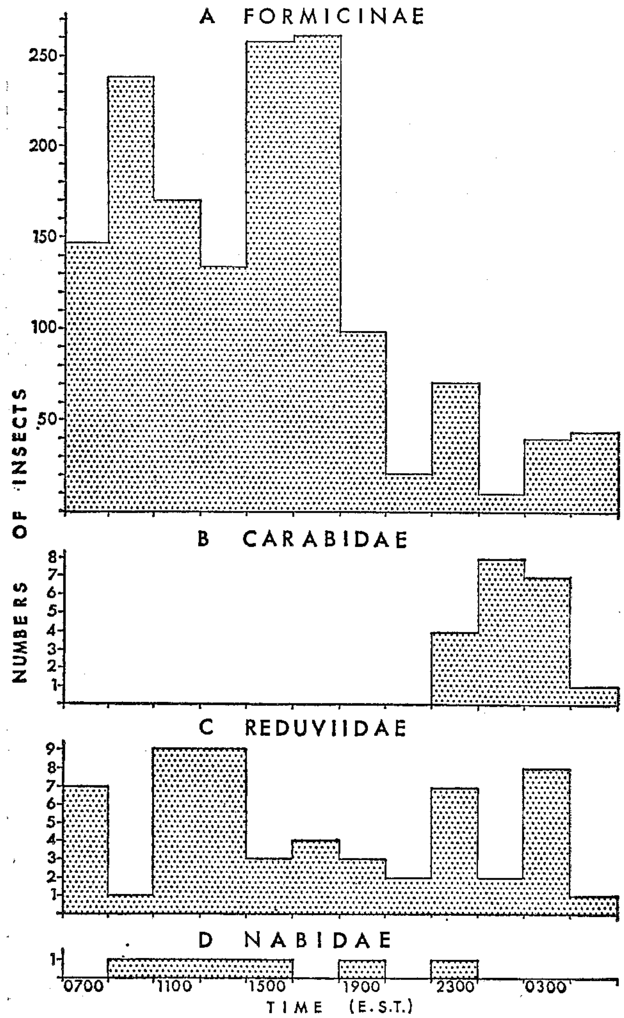

Fig. 1—Relation between time of day and number of predaceous insects collected from red pine. (Based on three replicates of four trees sampled every 2 hr.).

Two Rare Species of Pissodes Weevils.—In his "Contributions toward a Monograph of the Bark-weevils of the Genus Pissodes" (U.S. Dep. Agr., Bur. Entomol. Tech. Ser. 20, Pt. 1, 1911), Hopkins reported on seven species of North American *Pissodes* then already known and on 23 additional species named by himself. Since that time one further species, *terminalis*, has been described by Hopping. Hopkins, the sponsor of the host-selection principle, named many of his entities on the bases of host and locality, but some are quite clearly only geographic races or ecotypes.

Three of the smallest of his species, ranging from 3.7 to 5.5 mm. in overall length, are obviously close allies and either extremely rare or on account of their size escape detection. One, *similis*, was collected dead by Hopkins at "Camp Caribou, Maine, June 7, 1900, on dead branch of "witch's broom", on balsam fir. Larval mines and pupal cells were observed in adjoining twigs, and another dead specimen was taken at Waterville, N.H., . . . from a pupal cell in dead branch of "witch's broom", on balsam fir." The type specimen came from the Black Mountains, N.C. The second species, *utahensis*, is based on a specimen from Park City, Utah; others were from Bear Lake, B.C. Its host tree was unknown to Hopkins but he opted for *Abies*. The third and largest species, *barberi*, was collected at Redwood Creek, Humboldt Co., Calif., while others were taken at Astoria, Oreg., and Tenino, Wash. According to Hopkins the host tree is probably *Picea* spp.

On August 17, 1964, aware of the bizarre breeding site of *similis* and together with J. Grant of the Vernon Sublaboratory, a witches' broom was cut from an alpine fir growing near the summit of Silver Star Mountain (elevation 5800′) near Vernon, B.C. The broom yielded four adults, and pupal cells were observed in the dead wood. The malformed growth was caused by the rust *Melampsorella caryopyllacearum* Schroet. as it is elsewhere in Canada, and the specimens agreed precisely with Hopkins' description of *utahensis*. It is possible therefore to record witches' broom on alpine fir as the host-site of this species.

On June 15 and 22, 1965, witches' brooms on balsam fir were collected by D. Constable and V. Jansons respectively in the White River and Geraldton forest districts north of Lake Superior for examination in Sault Ste. Marie. Each provided a single adult of what is quite clearly *P. similis* Hopk. These then are, to the best of my knowledge, new distribution records for this species and in all probability the first reports of its occurrence in Canada. Regrettably, the third species, *barberi*, remains unknown to me.

Due to their peculiar association with witches' broom, *similis* and *utahensis* can scarcely be regarded as species of economic importance; they are reported here mainly for their intrinsic interest and as examples of what can be achieved by knowledgeable collecting.—S. G. Smith.

Fungi Isolated from Damping-off of Conifers in Ontario, 1964.—To provide a basis for comprehensive microbiological studies, data were collected on damping-off pathogens in the Midhurst nursery during June 1964. Microbes associated with diseased tissues of 200 conifer seedlings, mainly of red pine, *Pinus resinosa* Ait., were isolated and identified. Half of the seedlings were from seedbeds fumigated with Trizone the previous September, and half from comparable beds that were not fumigated. Further isolations were made from 41 apparently healthy seedlings in the same beds and from 200 diseased seedlings grown in nearby beds from seeds pelleted with captan fungicide, as well as from 89 diseased seedlings from another nursery (Orono). Pieces 2 to 10 mm. long were cut under aseptic conditions from seedlings rinsed in sterile water and plated in 1.5% agar with 50 ppm. neomycin and 30 ppm. streptomycin. The antibiotics were added to reduce bacterial antagonism to fungi. Placing the pieces well within the agar further reduced this antagonism. Replicate platings were made in agar which in addition to neomycin and streptomycin contained 50 ppm. mycostatin, an antibiotic selective for *Pythium*.

The following percentages show the incidences of the most important fungi isolated from the Midhurst nursery:

	Healthy seedlings		Diseased seedlings	
	Fumigated	Non-fum.	Fumigated	Non-fum.
Fusarium spp.	23	53	46	57
Alternaria spp.	46	29	49	39
Pythium spp.	0	0	11	17
Rhizoctonia spp.	15	4	5	8
Nematodes	0	0	12	6
Unidentified fungi	8	21	12	9
Miscellaneous fungi	31	39	16	59
Sterile tissues	8	12	6	17

The miscellaneous fungi were mainly *Trichoderma*, *Mortierella*, *Mucor*, and *Penicillium*, not suspected to be pathogenic. Bacteria and protozoa were not recorded because they are not known to be of importance.

The results of these studies show that: (a) four important genera have rapidly become established in the fumigated beds; (b) *Pythium* probably is an important pathogen; (c) *Fusarium*, *Alternaria*, and *Rhizoctonia* are frequent in healthy seedlings but mere isolation of these cannot indicate pathogenicity; their presence is explained partly by their occurrence as epipytes or as parasites causing no disease or only mild disease. The platings with mycostatin gave somewhat higher *Pythium* incidences and facilitated isolation of this fungus and also of nematodes. Most of the latter probably were not pathogenic.

Isolations from seedlings that grew from pelleted seeds gave similar results except that the higher incidence of *Rhizoctonia* (20%) suggests pathogenic importance. The same was true in isolations from Orono (*Rhizoctonia* 38%). These and additional data obtained for seedlings of 10 other conifers showed that the same genera of fungi were associated with damping-off in all the host species.

The most important of the fungal species identified were: *Pythium irregulare* Buism., *P. ultimum* Trow, *Rhizoctonia solani* Kuehn, *Thanatephorus praticolus* (Kotila) Flentje, *Fusarium oxysporum* Schlecht. emend. Snyder & Hansen, and *F. solani* (Mart.) Whet. emend. Snyder & Hansen. Less common but suspected of pathogenicity were: *F. roseum* (Cke.)

Snyder & Hansen, *P. oligandrum* Dreschsler, *P. acanthicum* Dreschsler, *P. rostratum* Butler, *R. endophytica* Saksena & Vaartaja, *Cylindrocarpon radicicola* Wr., *C. obtusipora* (Cke. & Hark.) Wr., *Helminthosporium* sp., *Curvularia* sp., *Stemphylium* sp., and *Phoma* sp.—O. Vaartaja and A. W. Hill.

PRAIRIE PROVINCES

Insects and Mites Associated with Black Knot of Cherry, Dibotryon morbosum (Schw.) Theiss. and Syd.— This disease is widely distributed in Manitoba and Saskatchewan on choke cherry, *Prunus virginiana* L. and pin cherry, *Prunus pennsylvanica* L.f. and in some years is very prevalent. When insect and disease surveys in the two provinces disclosed that a number of insects and mites inhabit the knots, a study was initiated to determine the species involved and whether they feed in the knots or merely utilize them for hibernation. Collections of knots from May to September in 1963 revealed the presence of the following insects and mites, identified by members of the Entomological Research Institute.

Order	Family	Species
Lepidoptera	Aegeriidae	*Synanthedon pictipes* G. & R.
	Carposinidae	*Carposina* sp.
	Gelechiidae	*Telphusa* sp.
	Tineidae	*Tinea* sp.
	Pyralidae	*Mineola tricolorella* Grt.
Diptera	Chloropidae	*Gaurax* poss. *montanus* Coq.
		Gaurax festivus Loew.
		Oscinella sp. nr. *catalpae* Mall.
Coleoptera	Melandryidae	*Canifa* sp.
	Curculionidae	*Conotrachelus nenuphar* (Hbst.)
Neuroptera	Chrysopidae	*Chrysopa* sp.
Acarina	Acaridae	*Thyreophagus* sp. nr. *corticalis* (Michael)
		Histiogaster sp.

The species most commonly encountered were a gelechiid, *Telphusa* sp., and the weevil, *Conotrachelus nenuphar* (Hbst.). These two species and a beetle, *Canifa* sp., are the only ones noted thus far actually feeding in the knots. It is known that certain species of the families Tineidae and Acaridae are fungivorous, but no evidence of feeding by members of these families has been observed in this study. Species such as *Synanthedon pictipes* G.&R. and *Mineola tricolorella* Grt., a borer and defoliator, respectively, on choke cherry, and the predator *Chrysopa* sp., probably overwinter in the knots.

This study has uncovered some interesting host associations. According to J. G. Chillicot the specimens of *Gaurax* are quite rare. Future studies will attempt to clarify the association of these insects and mites with the disease, and additional collections will be made to extend knowledge of the species complex involved.—H. R. Wong and J. C. E. Melvin.

The Host and Distribution of Agrilus criddlei Frost in Canada.—In his description of *Agrilus criddlei,* Frost (Can. Entomol. 52:249-250.1920) indicated that it was known only from Aweme, Manitoba (the type locality); Toronto, Ontario; and Rigaud, Quebec. Fisher (Bull. U.S. Nat. Mus. 145. 1928) was unable to add to the known distribution of the species or to indicate its host in a revision of the North American species of the genus *Agrilus.* Additional information has since been obtained on the distribution of this species in Canada through H. F. Howden of the Entomological Research Institute, Ottawa, and from regional units of the Canadian Forest Insect Survey. Recent investigations on insect-produced galls on forest trees and shrubs in Manitoba and Saskatchewan have disclosed the host and some aspects of the seasonal activity of *A. criddlei* in this region.

To date, the only identified host of the species in Manitoba and Saskatchewan is *Salix bebbiana* Sarg. but other willow species may also be attacked. The female borer usually oviposits in the upper portion of the main stem or larger branches on open-growing willow clumps. During early stages the larvae feed mainly in the cambium and sapwood. This disturbance causes abnormal stem swelling and the production of a "gall" that may range in size from a slight swelling to twice the normal diameter. Immediately below the gall, the stem is somewhat constricted and narrower than the corresponding point above the area of attack. The portion of the stem beyond the gall ultimately dies.

Dissections of galls during the early winter revealed only a single larva in each of the galls examined; at least two instars have been found, and there is evidence to suggest that more than 1 year is required to complete the life cycle. After girdling the sapwood, the mature larva enters the heartwood and tunnels beyond the gall to a location near the surface where it constructs a pupal cell. Frass is packed tightly behind the larva in the tunnel. The larva overwinters in a U-shaped position with the head directed toward the stem's surface. Pupation occurs the following spring and the adult emerges about mid-July through a D-shaped hole.

Nine new distributional records have been obtained for Canada: Boiestown, New Brunswick; Bridgeport and South March, Ontario; Beaver Creek north of Riverton, Pine Falls, Riding Mountain National Park, and Spruce Woods Forest Reserve, Manitoba; Katepwa, Saskatchewan; and Calling Lake, Alberta.—H. R. Wong and B. B. McLeod.

BRITISH COLUMBIA

Observations of Overwintering Psuedohylesinus and Trypodendron.—Most adult bark beetles overwinter under the bark of the host trees or logs in which they have developed. Some drop and enter the bark of duff at the base of the host tree. Others fly to suitable habitats to hibernate in the forest duff, in the bark at tree bases, or in twigs and branches in the crowns (Chamberlin, W. J. 1958. The Scolytoidea of the Northwest, Oregon, Washington, Idaho and British Columbia. Oregon State Coll., Corvallis, Oregon.).

In November **1964, two bark beetle** species, *Pseudohylesinus granulatus* (LeConte) and *Pseudohylesinus grandis* Swaine, were found near Cowichan Lake, Vancouver Island, hibernating in the bark of green trees standing next to a clear-cut area. This area was logged the previous winter and burned in the autumn of 1964. These beetles, as well as *Trypodendron lineatum* (Oliv.) (Dyer and Kinghorn, Can. Entomol. 93: 746-759. 1961), had apparently bred in the slash and stumps and moved into the forest edge to overwinter. The forest comprised several species of large, mature conifers. The following table shows the number of beetles found in 1 sq. ft. of bark from the base of each of five adjacent trees, about 50 ft. from the stand edge.

Tree species	*Trypodendron lineatum*	*Pseudohylesinus granulatus*	*Pseudohylesinus grandis*
Amabilis fir[1]	49	27	3
"	24	16	8
"	12	1	5
Douglas fir[2]	149	0	0
Western hemlock[3]	17	0	0

[1]*Abies amabilis* (Dougl.) Forb. [2]*Pseudotsuga menziesii* (Mirb.) Franco. [3]*Tsuga heterophylla* (Raf.) Sarg.

It appears that *P. granulatus* selects *Abies* bark for hibernation. Its borings produced a conspicuous brown dust which was observed from ground level to about 8 ft. on the tree bole. Entrance holes were most dense near the ground and some were just below ground level. The beetles bored nearly straight galleries from 6 to 15 mm. into the bark but did not quite touch the cambium. As many as four beetles entered by the same hole and made separate niches close together in the inner bark. *T. lineatum* frequently occupied the same hole. A few *P. grandis* were also found in *Abies* bark where each beetle had made a single short tunnel, about 5 mm. long. Neither *P. granulatus* nor *P. grandis* were found in samples of about 20 sq. ft. of duff from tree bases in the same location although hundreds of *T. lineatum* were present. From numerous samples of bark and observations of the boring dust it was found that most of the *P. granulatus* overwintered within about 75 ft. of the forest edge, but a few could be found 200 ft. into the stand. Damaged bark around the entrance holes indicated that woodpeckers had found many of these beetles.

Chamberlin (*loc. cit.*) states that *P. sericeus* (Mann.) and *P. grandis* were found hibernating as adults in the thick moss which grows abundantly on the trunks of oak trees in Oregon adjacent to stands of second-growth Douglas fir. Although there were dense patches of moss growing on the trunks of the amabilis fir in British Columbia, *P. granulatus* had frequently penetrated the moss and bored into the bark.

Identification of these beetles was made by D. Evans of the Victoria laboratory.—E. D. A. Dyer and W. W. Nijholt.

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O. H. M. S.

DOUGLAS C. EIDT,
FOREST ENT. & PATH LAB.,
CANADA DEPT. OF FORESTRY, (3-6)
COLLEGE HILL, L-205
FREDERICTON, N.B.

DEPARTMENT OF FORESTRY
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QUEBEC

Discovery of the Beech Scale, Cryptococcus fagi (Baer.), in Quebec.—In June 1965, beech trees with the white wool and nymphs of the beech scale were observed at Les Etroits, Temiscouata County, Quebec. Officers of the Entomology Research Institute, Ottawa, confirmed the identification and this collection represents the first record of the scale in Quebec. The nearest known infestation was recorded at Clair, N.B. in 1961 (Forbes *et al.*, Can. Dept. For. Ann. Rept. For. Ins. and Dis. Surv. 1961). The American beech is an important component of the hardwood forest of the area, most commonly growing in association with sugar maple and white birch. At Les Etroits beech has practically reached its northern limit of distribution.

Later in June, the insect was found at two other places covering a total area of 15 square miles. The volume of the stands was estimated to be from 15 to 25 cords to the acre, the proportion of beech varying from 50 to 75% and its diameter from 3 to 20 inches. In the three locations, the proportion of infested trees was less than 1% and the degree of infestation was estimated as light. In each case, the infested trees occurred in small patches and the scale was found on trees of different sizes, mostly on the lower 6 feet of the trunks. On one 9-inch tree, the insect was found from ground level to the base of the crown.

Although *Nectria coccinea* var. *faginata* Lohm., Wats. and Ayers, associated with the beech scale as the cause of the beech bark disease in the Maritime Provinces, was not found on the insect-infested trees, *Nectria galligena* Bres. (as verified by R. H. Arnold, Plant Research Institute, Ottawa) was present on all the infested trees examined. The fungus had just penetrated the bark of one tree but definite cankers were apparent on others. One tree had died recently.—R. Martineau, C. Monnier, and G. B. Ouellette.

ONTARIO

The Introduced Leaf-mining Sawfly, Fenusa pusilla (Lep.), on Birch.—The first Canadian record of this leaf miner was apparently from Quebec in 1929 (Daviault, L., Contr. Inst. Zool. No. 1, Univ. of Montreal, 1937). It was recorded from New Brunswick in 1933 (Friend, R. B., Conn. Agric. Exp. Sta. Bull. 348), and by 1936 it was well established in eastern Ontario (67th Annual Rep. Ent. Soc. of Ont.) Since 1939 the species has been recorded in the Annual Report of the Forest Insect and Disease Survey of the Department of Forestry of Canada from Calgary, Alta., eastern and southern Ontario, Quebec, and the Maritime Provinces.

Since 1959, when the results of a study of the larvae of leaf-mining sawflies on birch in Ontario were published (Lindquist, O. H., Can. Entomol. 91: 625-627. 1959), the annual spread of *F. pusilla* to the north and west has been recorded by the Forest Insect and Disease Survey. A summary of distribution records is presented in Fig. 1.

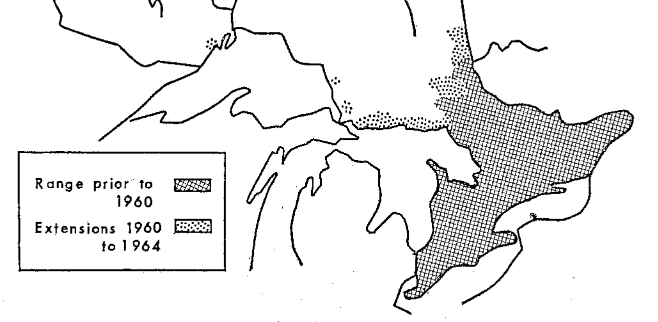

FIGURE 1 Distribution of *Fenusa pusilla* (Lep.) in Ontario.

When plotting distribution points it was obvious that the spread to the west and north was not always a gradual one. In a few instances new infestations occurred some distance from any known distribution point such as the one that persisted on shade trees in the cities of Fort William and Port Arthur from 1962 to 1964. It is probable that infestations in these cities and other urban centres originated from the importation of infested nursery stock.

Since the species was first detected in these cities in 1962, K. C. Hall has conducted extensive insect surveys in adjacent forests. In the summer of 1964, the miner was found for the first time in young white birch stands 5 miles west of Port Arthur. Surveys by M. J. Applejohn in the Swastika forest district along the Ontario-Quebec border revealed that spread in this area has been slow and erratic.

Because young birch trees are a common component of forests throughout Ontario, it is expected that *F. pusilla* will continue to spread, albeit slowly, over a much greater area.—O. H. Lindquist.

Eriophyid Mites on Conifers.—During the past 5 years eriophyid mites have been collected frequently by the field staff of the Forest Insect and Disease Survey in Ontario. Representative samples of these mites were submitted to E. E. Lindquist, Entomology Research Institute, Ottawa, for identification. Although information on these species is somewhat meagre, the following brief notes, particularly those on hosts, should aid in the identification of those closely related species of mites.

Trisetacus grosmanni Keifer (1959).—This species is close to *Trisetacus pini* (Nalepa). Infested terminal buds of balsam fir are globular, usually with the interior destroyed. The damage becomes evident after healthy buds open in the spring. This mite is common on balsam fir throughout Ontario. It is rare on white spruce, being known only near Sudbury, where it causes bud damage similar to that on balsam fir. Buds of larch from the Fort Frances District showed similar damage caused by *Trisetacus pini* sp. complex near *grosmanni* Keifer and specimens similar to *T. grosmanni* were found in bud-like galls on red pine twigs.

Trisetacus alborum Keifer (1963).—This species is regularly found on white pine, and a similar form also occurs on red pine. The damage to white pine, usually appearing as a stunted needle cluster in a yellowish discoloration on the new shoot, is similar to that caused by *T. pini* (Nal.) and reported by Forbes (Bi-mon. Prog. Rept. 11(4):1. 1955). On red pine, galls consisting of persistent bud-like proliferations (up to 4 cms. in diameter) are formed over 1 or 2 years, mostly on the upper surface of the twigs. Damage occurs commonly on white pine and sporadically on red pine throughout the respective ranges of these hosts in Ontario.

Trisetacus sp. near *ehamanni* Keifer 1963 (=*pini* of Keifer 1938 and 1952, not *Nalepa* 1887). Damage to jack pine caused by this mite consists of shortened needles. Jack pine is regularly attacked in central and southern Ontario.

Setoptus jonesi (Keifer). Damage, consisting of shortened needles, was recorded once, namely, on Scots pine in the Lindsay District.—A. H. Rose.

Laboratory Overwintering Temperatures for Two Anisota Species.—During an average year the Forest Insect and Disease Survey at Sault Ste Marie, Ontario, collects about 12,000 samples of forest insects, half of them containing representatives of some 950 lepidopterous species. Most of the samples are collected when the insects are in the larval stage. The larvae are reared to facilitate accurate identification and to provide information on parasites. The rearings are carried out at 72°F and 70% relative humidity, followed by overwintering, when necessary, at 35°F with subsequent return to rearing conditions. There has always been considerable mortality in winter rearings and it is suspected that an unsatisfactory temperature regime contributed to it. Thus, when D. R. Wallace (personal communication) found that *Neodiprion* larvae overwintering at 45°F produced more successful adult emergence than those overwintering at 35°F, it was decided to compare the effect of overwintering temperatures on some lepidopterous species in an attempt to improve rearing techniques.

The material used in this test consisted of *Anisota rubicunda* Fab. and *A. senatoria* (J. E. Smith). Late larvae of both species were collected; *A. rubicunda* from red maple, *Acer rubrum* L., near Sudbury in early August, 1960; and *A.*

92538

senatoria from red oak, *Quercus borealis* Michx., near Trenton about mid-August, 1960. These two species were selected for the test because *A. senatoria* is essentially a southern species and *A. rubicunda* is found in more northerly parts of Ontario. The field-collected larvae were reared in the laboratory and the pupae of each species were then divided into 32 lots of 50 specimens. Two lots of each species were exposed to 25°F for 90 days and one lot of each species was exposed for a period of 30, 60, 90, 120, 150, 180, or 210 days to each temperature regime (35°F and 45°F). After exposure to these conditions, the material was returned to 72°F. and 70% relative humidity, for completion of rearing.

Ninety days of pupal exposure at 25°F caused complete mortality of both species. Except for *A. senatoria* stored for 60 days, there was no significant difference in the amount of adult emergence of either species stored at 35°F or 45°F for each storage period (Fig. 1). However, the amount of adult emergence was affected by the duration of cold storage of the pupae with both species showing highest emergence after 120 days exposure to both storage temperatures. Data for *A. rubicunda* at 35°F after 150 days of cold storage were omitted because of high mortality presumably caused by a fungus disease. Both R. W. Salt (Can. J. Res., D 25:66-68. 1947) working with the sawfly *Cephus cinctus* Nort. and W. E. Steenburgh (Sci. Agr. 9:617-618. 1929) with the moth *Laspeyresia molesta* Busck. recorded increased survival following increased time in cold storage. However, neither of these authors indicated an optimum cold storage time such as there seems to be in the *Anisota* species. It is fairly clear that pupae of both species require an exposure of at least 120 days at 35°F or 45°F to assure reasonably high survival, but the optimum period of exposure probably falls between 150 and 180 days for *A. rubicunda* and 120 and 150 days for *A. senatoria.*

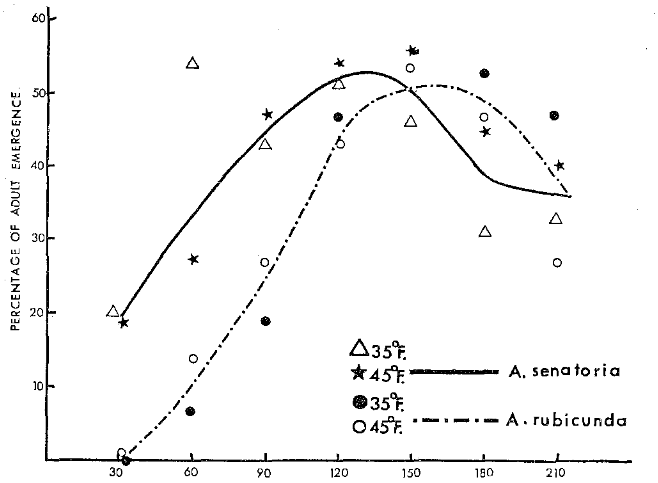

FIGURE 1 Percentage of adult emergence of *A. senatoria* and *A. rubicunda* following exposure of pupae to temperatures of 35°F and 45°F for periods ranging from 30 to 210 days.

The incubation period to adult emergence varied inversely with the duration of the period of cold storage to which the pupae were exposed (Fig. 2). Data for the 30-day exposure are omitted because there were only a few survivors of *A senatoria* and none of *A. rubicunda* at either cold storage temperature. Generally, *A. senatoria* required a longer incubation time than did *A. rubicunda*. However, in one or two instances there were significant differences in the number of days of incubation required by pupae of both species stored at 35 and 45°F. C. M. Williams (Biol. Bull. 110:210-218. 1956) working with *Platysamia cecropia* L. found that pupae were physiologically capable of further development after 10 weeks of exposure to temperatures ranging from 6 to 15°C. Below this temperature range development was delayed another 5 weeks. The temperatures used in this study did not cause appreciable difference in the time required to complete development; in fact, at each temperature regime there was a greater difference in incubation time between species than within species. This suggests that incubation time may be an adaptation to habitat since the northern species, *A. rubicunda*, required less time than the southern species, *A. senatoria.*

In addition to the above tests, supplementary observations were made on: (1) the effect of holding pupae at the rearing temperature (72°F) for periods up to 90 days before exposing them to low temperatures; and (2) the effect of exposing pupae to normal outside temperatures until the first frost. Neither of these treatments had any effect on survival.

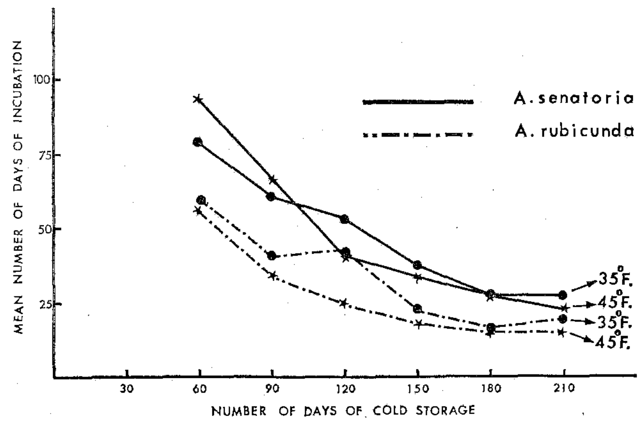

FIGURE 2 Mean number of days of incubation of *A. senatoria* and *A. rubicunda* following cold storage at two temperatures for periods ranging from 60 to 210 days.

The Forest Insect and Disease Survey is involved in the rearing and overwintering of many species of insects, each of which has its own specific requirements for optimum survival. Our knowledge of satisfactory rearing conditions will improve with experience, but our work with sawflies and two species of *Lepidoptera* indicates that storing pupae at 45°F for about 120 days generally satisfies our rearing requirements. —A. H. Rose.

***Waitea circinata* and its *Rhizoctonia* Stage in Ontario.** —*W. circinata* was found for the first time in Ontario in the Midhurst Forest Nursery. The organism was trapped in a piece of buckwheat stem incubated in the nursery soil. The characteristics of the Ontario isolate differ from the description of the species given by J. H. Warcup and P. H. Talbot (Trans. Brit. Mycol. Soc. 45: 495-518. 1962) in two respects: Among those basidia with typically four sterigmata, about 5% had five sterigmata; and the length and septation of basidia varied more, some of the winiform or cylindrical basidia being up to 31 mu long and a few with one cross septum or, rarely, two. Only one Ontario isolate so far has exhibited a tendency to form the perfect stage in culture.

The *Rhizoctonia* stage of *W. circinata* is peculiar because of its sclerotia, which on cornmeal agar are red, almost spherical, up to 2 mm. in diam., made of very tightly packed cells. On malt agar the sclerotia are looser, larger, irregular in shape and eventually brownish. In the Ontario isolate the side branches formed a network of numerous anastomosing hyphae. Vacuolation of the cell content took place earlier and in thinner hyphae than in other common *Rhizoctonia* species. The chlamydospores were not abundant on cornmeal agar. On malt agar the chlamydospores became very large up to 25 × 15 mu.

Among a few hundred *Rhizoctonia* isolates from Ontario nurseries, those close to *W. circinata* seem to stand out as a population distinct, e.g. from the very common *Rhizoctonia praticola* (Kotila) Saksena and Vaartaja, only a few isolates showing intermediate characteristics. Attempts should be made to segregate other distinguishable species from *Rhizoctonia solani* Kuehn as the practice of lumping almost all species into *R. solani* impedes our understanding of these important root parasites.—O. Vaartaja.

Is Fusarium Roseum the Correct Name for Rhizoctonia Lilacina?—The changing generic concept of *Rhizoctonia* was recently discussed by Vaartaja and Saksena in "Taxonomy, morphology, and pathogenicity of *Rhizoctonia* species from forest nurseries" (Can. J. Botany 39: 627-647. 1961). This paper described a virulent isolate, No. 1142, from Sutherland nursery, Saskatchewan. The morphology of this isolate essentially agreed with *Rhizoctonia lilacina* Sappa and Mosca. This species lacks both sclerotia and the characteristic "Rhizoctonia" branching, and the arrangement of the chlamydospores is not typical of *Rhizoctonia*, often being intercalary. Therefore it does not fit the modern concept of *Rhizoctonia*. The use of the name *Rhizoctonia lilacina* was defensible only because no better name was available.

The following new data confirm that the isolate 1142 is not a typical *Rhizoctonia* species. When grown on a mixture of water agar and cornmeal agar (1:1), it sometimes produced a few conidia, in clusters of 2 to 6, attached to prostrate, irregularly branched conidiophores. The conidia were ellipsoid or spindle-shaped with rounded tips, usually one-celled, rarely with one cross-wall in the middle. Conidial measurements were 5-16 × 3-4 mu. The characteristic accumulation of reddish, brownish and yellow pigments or crust in the medium and on some hyphae suggested comparison with certain isolates of *Fusarium roseum* Lk. emend. Snyd. & Hans. A peculiarity of the isolate studied was frequent alternation of thick and thin cells, or groups of cells, in a single filament. This was also found in a few isolates of *F. roseum.*

The similarities found in pigments, mycelial dimensions, branching and spores, as well as the well-known tendency of *Fusarium* to mutate in culture, suggest the following conclusion: isolate 1142, and probably also the type of *Rhizoctonia lilacina* which was not available, might be considered as unusual variants of a species of *Fusarium,* probably *F. roseum.* Such variants have reduced tendency to form conidia and an increased tendency to form chlamydospores. As this variant lacks some characteristics used for species identification within *Fusarium,* an exact determination is not possible.—**O. Vaartaja.**

PRAIRIE PROVINCES

Two Species of Gall-producing Saperda in Manitoba and Saskatchewan.—In an early monograph of the genus *Saperda* Felt and Joutel (Bull. New York Mus. 74. 1904) reported that *S. concolor* LeConte produces galls on poplars and willows, and that *S. moesta* LeConte, which they considered to be a subspecies of *S. populnea,* produces galls on balsam poplar. Craighead provided essentially the same information (U.S. Dept. Agric. Misc. Pub. 657. 1950). In more recent references Graham *et al.* (Aspens. Univ. of Mich. Press. 1963) report that both *S. concolor* and *S. moesta* produce galls on poplars, while MacAloney and Ewan (U.S. For. Service Res. Paper LS-11. 1964) report them on aspens and willows.

Identifications by the Entomology Research Institute, Ottawa, of *Saperda* spp. reared from galls of poplars and willows in Manitoba and Saskatchewan by the Forest Insect Survey reveal that *S. concolor* and *S. populnea moesta* are apparently host-specific in this region and that they form distinctive galls. The galls of *concolor* were collected mainly from various species of willow and only rarely from reproduction trembling aspen. With the exception of a single collection on trembling aspen the galls of *S. populnea moesta* were observed only on balsam poplar and never on willow. The female of the former species selects for oviposition, a stem that is 3 or more years old and makes one to nine U-shaped egg scars around it. The resulting gall is about 2½ inches long and 1¼ inches wide with a fluted appearance; longitudinal depressed areas between ridges of normal growth result from the death of cambium in the vicinity of the oviposition scars. *S. populnea moesta* restricts its attack to stems less than 3 years old and makes only a single U-shaped oviposition scar. The resulting gall is ovoid in shape, relatively smooth in appearance, about 1½ inches long and ¾ inches wide, and is slightly flattened on the side where the scar has killed the cambium.

Both species apparently prefer small trees or shrubs growing in the open or along the fringe of forest stands, and their attacks usually cause the portion of the shoot above the gall to die and become susceptible to wind breakage.

These observations were made in the course of a current investigation of insect-produced galls on forest trees and shrubs in this Region.—H. R. Wong and B. B. McLeod.

ROCKY MOUNTAIN REGION

Photosynthetic Capacity of Mined Needles.—The larvae of the lodgepole needle miner, *Recurvaria starki* Free. feed upon the mesophyl of the needles of lodgepole pine, *Pinus contorta* var. *latifolia* Engelm. leaving the epidermal layers intact (Can. Entomol. 86: 1-19. 1954). In the early stages of the life cycle only the distal part of the needle is mined but the effect on the photosynthetic capacity of the non-attacked basal part of the needle was unknown. To test this effect the rate of oxygen evolved during photosynthesis from needles with different degrees of mining were compared with non-attacked whole and cut needles in an illuminated Warburg respirometer.

Twenty-five needles were selected at random from 1- and 2-year old sun foliage, and placed in 1 ml. of water in a reaction flask and illuminated with 2100 ft-c. of incandescent light. A constant CO_2 partial pressure of 0.03% was maintained by placing a carbonate-bicarbonate buffer solution in the centre well of a reaction flask with a filter paper wick. All tests were made at 25°C. Readings were begun after a 20 min. equilibration period and continued every 13 min. for 130 min. A thermobarometer containing the water but no needles was used to compensate for any change in temperature or pressure which took place during each test.

Photosynthetic rates were expressed as volume of oxygen evolved per millilitre of green tissue per hour. The volume of tissue in each flask was determined after the photosynthesis study by volume displacement following a technique similar to that of Clark 1961 (Tech. Publ. 85, State Univ. College of Forestry, Syracuse Univ.), except that ethyl alcohol was used instead of water to reduce the formation of air bubbles. The mined portion of the needle was cut off before the volume measurements so that only green tissue remained.

Three series of tests were made: in the first the twelve flasks were divided equally between whole green needles and 50% mined needles, in the second between whole green needles and 25% mined needles, and in the third between whole green needles and 50% mined needles and 50% cut needles. The results of each series and its replicate are given below.

	ul O_2/ml green tissue/hr.			
	Whole Green Needles	50% Mined Needles	50% Cut Needles	25% Mined Needles
June 11	38.33	42.38		
June 16	17.15	13.52		
June 17	31.90			32.17
July 9	14.57			19.28
July 10	18.33	21.95	21.35	
Aug. 5	28.97	22.32	28.42	

Large differences were found between runs but t-tests within run indicated no significant difference between O_2 evolved per volume of green tissue in mined, cut, or whole needles. Thus on the basis of this limited test it was concluded that differences in photosynthetic rates between mined and non-mined needles were in proportion to the tissue removed.—P. I. Van Eck and R. F. Shepherd.

BRITISH COLUMBIA

A Preliminary Study of Mycangia in the Bark Beetles, Dendroctonus ponderosae Hopk., Dendroctronus obesus Mann., and Dendroctonus pseudotsugae Hopk.—Recently it has been shown that many scolytid ambrosia beetles possess specialized structures or mycangia in which spores of their symbiotic fungi are transported from one host to another. For many years investigators have recognized a close association between blue-staining fungi and bark beetles and Francke-Grosmann (Z. ang. Entomol. 52: 355-361. 1963) has described mycangia in the bark beetle *Ips acuminatus* Gyll. containing spores of a blue-staining fungus associated with this insect.

Bark beetles of the genus *Dendroctonus* in logs or trees are often associated with blue-staining fungi and preliminary studies were carried out to determine whether three native species, *Dendroctonus ponderosae* Hopk. (the mountain pine beetle), *Dendroctonus obesus* Mann. (the spruce beetle), and *Dendroctonus pseudotsugae* Hopk. (the Douglas-fir beetle) possess mycangia or specialized structures in which blue-staining fungi are carried.

All beetles examined were excavated from their host and kill-fixed in alcoholic Bouin's solution, dehydrated in tertiary butyl alcohol, wax embedded, sectioned, and stained with a modified Gram-Weigert stain. This stain shows a clear differentiation between fungus material and insect tissue (Fernando, Ann. Mag. Nat. Hist. Ser. 13(2), 475-480. 1960; Farris, Can. Entomol. 95: 257-259. 1963).

In *D. ponderosae,* structures were found in the pregular region of the head which seemed to be associated with the oesophagus and contained material, assumed from its staining reaction to be fungus. Of 21 specimens examined, 12 females and four males had fungoid material in this location, but these structures in the other five females were empty.

Similar structures were not found in either sex of *D. obesus.* However, stained sections of this species showed fungoid material in the hollow interior of apodemes associated with coxal cavities of both sexes. Of 36 specimens examined (18♀ and 18♂) only one male had fungoid material, whereas eight females had deposits of the material in one or more of these structures. In addition, six specimens had similar fungoid material in the integumental folds associated with the scutellum. Most of the *D. obesus* specimens were teneral adults, which might not be expected to have as much fungus as older beetles; the mycangia in the late pupae and teneral adults of some ambrosia beetles are void of fungus.

All specimens of *D. pseudotsugae* examined were teneral adults and of 25 individuals studied, only one female had fungoid material in the apodemes associated with the forecoxal and metacoxal cavities. The same specimen also had similar material in the integumental folds of the scutellum. No other deposits or concentrations of fungoid material were found.

Further studies are being made of the occurrence of fungi in these species of *Dendroctonus,* and older beetles are being used to avoid the uncertainties associated with teneral adults. If blue-staining fungi are related symbiotically with beetles of this genus, the constant occurrence of fungi in individuals ready to fly may be expected.—S. H. Farris.

Severe Mineral Deficiencies in Douglas-fir Seedlings in a Newly Developed Forest Nursery.—Phosphorus deficiency symptoms appeared during August 1964 in 1 - 0 Douglas-fir seedlings growing in a new forest nursery, formerly farmland, at Duncan, B.C. The symptom severity varied in different parts of the nursery from only slight needle discoloration, to severe discoloration with stunting, to complete necrosis. However, throughout the whole area there were isolated patches of up to 30 seedlings with no deficiency symptoms.

Soil and foliage analyses made in November on samples from each symptom class (by J. T. Gillingham, Department of Agriculture, Experimental Farm, Saanichton, B.C.) showed low P and K values in several instances (Table 1). Average soil pH was 5.7.

TABLE I

Nitrogen, phosphorus, and potassium contents of soil and foliage samples from Douglas-fir nursery beds in relation to mineral deficiency symptoms

Symptom Class	Nitrogen Needles[a]	Phosphorus		Potassium	
		Needles[b]	Soil[c]	Needles[b]	Soil[c]
Thrifty, slight discoloration	2.03	0.09	6.2	0.83	44.2
Stunted without discoloration	2.80	0.08	4.2	0.55	48.5
Stunted with discoloration	2.41	0.03	5.7	0.50	44.2
Dead	1.65	0.03	5.0	0.30	34.0
Isolated patches of thrifty	2.20	0.10	7.0	0.75	34.0
Adjacent patches of stunted seedlings	2.52	0.05	6.5	0.44	45.0

[a]% expressed on moisture free basis.
[b]% moisture free basis. Phosphorus determined by method of Smith, G. R. et al. Can. J. Research 17, 178–191, 1939. Potassium determined with an oxy-hydrogen flame using a Beckman Model B flame photometer.
[c]parts per million.

The following April, 285 lbs/acre of ammonium phosphate were applied to the area, followed by a further 240 lbs. in June. Also, 120 lbs./acre of potassium sulphate were added in June and again in July. By the middle of August, the deficiency symptoms had disappeared and growth was comparable to that in the older nurseries.

P and K deficiencies have not occurred in the older part of the nursery at Duncan, therefore one would suspect that some factor or factors connected with the previous or present treatment of the area had a bearing on the situation. For instance, there was an almost complete lack of deficiency symptoms from an area formerly producing potatoes in contrast to the widespread symptoms in areas previously under grass or grain crops. Secondly, the size and distribution of small patches of thrifty seedlings, surrounded by large areas of stunted stock, strongly suggested "Juno" spots, caused by cattle droppings in pastures. Thirdly, the continuous removal of heavy weed growth (mainly clover and equisetum) during the first summer of nursery operations is suspected to have contributed to depletion. It is necessary to point out that the author has never seen such abundant weed growth in nursery beds, and that approximately 25 weeders, fully employed during the entire growing season were unable to keep pace with the growth. Whole plants of equisetum had, on analysis, 0.16% P and 1.72% K (moisture-free basis) thus greatly exceeding the content of Douglas-fir seedlings and presumably representing a substantial drain from the soil.

Vancouver Island soils are known to be low in phosphorus (Gillingham, J. T., Soil Sci. *In press*) so that a logical interpretation of the evidence would include a low initial P and K level in the soil of the area in question, aggravated by depletion to the point of causing deficiency. Variations in P and K content of soil and tissues apparently related to previous land management, tend to support rather than refute this.—W. J. Bloomberg.

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MARITIME PROVINCES

The Beech Bark Disease in the Maritime Provinces.—The beech bark disease, attributed in North America to the beech scale, *Cyptococcus fagi* (Baer.), and the fungus, *Nectria coccinea* (Pers. ex Fr.) Fr. var. *faginata* Lohm., Wats. and Ayers, has caused serious mortality and injury to beech, *Fagus grandifolia* Ehrh., in the Maritime Provinces of Canada and northeastern United States. The insect and fungus also occur in the State of New York. The insect, recently found in Quebec (Martineau, R., C Monnier, and G B Ouellette. Bi-mon. Prog Rept. 21(5):1, 1965), is known to occur in New Jersey (U.S. Dept. Agri. Coop. Econ. Ins. Rept. 15(31):870, 1965) and in Pennsylvania (Shigo, Alex L. U.S. Dept. Agri. For. Pest Leaf, 75, 8 pp., 1963).

In the past, utilization of beech in the Maritime Provinces was confined largely to firewood and hardwood flooring. Now beech is used for additional products including school furniture, veneer, and corrugated fillers for cartons.

The beech scale was introduced from Europe prior to 1890 and was first found in North America at Halifax, Nova Scotia. Records of its spread in the Maritime Provinces to 1942 were summarized by Hawboldt (Acadian Nat. 1(4): 137-146, 1944.) and to 1948 by Reeks, Forbes, and Cuming (Can. Dept. Agric. Ann. Rept. For. Ins. Surv., 1948: 9-26. 1949.). The *Nectria* fungus, first reported in Nova Scotia in 1930 by Faull (Nova Scotia Dept. Lands and Forests Ann. Rept., 1929: 36-40. 1930.), and studied by Ehrlich (Can. J. Res. 10: 593-692, 1934.), is now known to occur throughout the Maritimes. The map shows the known northern limits of the insect in 1948 and delimits the areas in New Brunswick where the scale and the fungus have been found since then.

The beech scale in North America overwinters as a dormant nymph with its stylet inserted in the bark. The insect completes its development by early summer and lays eggs mostly in late June and July. Hatching usually begins in August. The young nymph is motile until early autumn, when it inserts its stylet into the bark, and secretes a white, waxy wool covering. There is one generation a year. Reproduction is parthenogenetic and males are unknown.

The *Nectria* fungus apparently infects the tree through tiny ruptures in the periderm resulting from death and shrinkage of the cells on which the insect feeds. Reddish stromata develop about a year after the bark becomes infected. These produce white sporodochia and, later, bright red, lemon-shaped perithecia. Ehrlich believed that the fungus is spread to individual trees mainly by air currents and rain water.

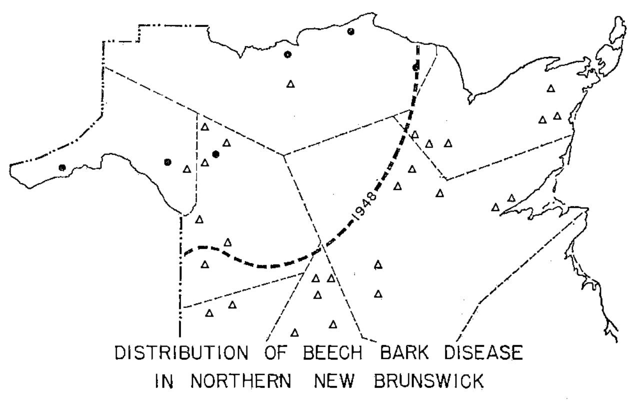
Light infestations of the insect, characterized by irregular vertical lines of 'wool' following bark crevices, cause little injury to the tree. In severe infestations, when the bark becomes covered with a white felt-like mass, patches of bark and cambium may be killed and the vigor of the tree reduced. Ehlrich indicated, however, that beech is not killed by the scale alone. In North America moderate to severe infestations of the insect are usually followed by *Nectria* infections. Typically, the fungus infects and kills the living tissues of the bark, cambium, and sapwood, thus disrupting the transport and storage of food. Lesions often coalesce and girdle the trunk and this results in the death of the tree. On vigorous trees a secondary layer of bark is sometimes formed. Frequently trees produce callus tissue around the wounds to form cankers; often these trees have many dead branches and become decadent. Some trees may be killed in 1 or 2 years following infection. It appears that infestations of the scale are necessary for fungus infection and that the fungus, once established, is the key factor in killing the tree.

Sampling by Ehrlich in stands in Nova Scotia and southern New Brunswick in the early 1930's showed that about half of the beech trees in areas of older outbreak were dead, and that the larger trees were more often killed. Also, it is clear from accounts by Hawboldt and by Barter (Bi-mon. Prog. Rept. 3(4): 1, 1947.) that most of the mature beech trees in Nova Scotia, Prince Edward Island, and southern New Brunswick were destroyed and the survivors badly cankered by the mid 1940's. Further, Barter (Bi-mon. Prog. Rept. 9(3): 1, 1953.) concluded that by 1952 about 20% of the stems and 40% of the volume of beech had been killed in the Fredericton area.

Observations of some of the younger residual trees on plots established between 1948 and 1961 in Nova Scotia and New Brunswick indicate that: (1) the proportion of uninfested trees has decreased in all areas (greatest reduction at Bayview, Digby County, N.S., where the proportion of uninfested trees was reduced from 61% in 1957 to 1% in 1964); (2) most trees are lightly infested by the beech scale and lightly infected by the *Nectria* fungus and, in areas of older infestation most such trees are cankered as a result of previous attack by the insect and the fungus; (3) mortality of stems has averaged about 11%; (4) decadence and mortality are more common in the larger diameter classes; and (5) beech scale infestations are generally very light toward the northern limits of outbreak in New Brunswick where more frequent low winter temperatures keep scale numbers low. Thus it appears that the proportion of trees infested by the scale has increased but that the current infestations by the scale and infections by the fungus are less severe than in the 1930's and that fewer trees are being killed. Factors responsible for these decreases in severity of attack and mortality include the relative scarcity of large, mature beech trees and extremely low temperatures during several winters in recent years.

Winter temperatures of —35°F. or lower cause high mortality of the beech scale above the snow line (Crosby, D. and T. W. Jones. Soc. Amer. For. New England Sect. Tree Pest Leaf. No. 4 (rev.), 4 pp., 1950.), and this is probably the most effective factor in checking the development and spread of beech scale attacks. A native ladybird beetle, *Chilocorus stigma* (Say), feeds on the scale. Barter (1953) presented evidence that this predator may have been important in reducing scale populations in the Fredericton area in the mid-1940's, but the value of the predator in control has not been studied intensively. Several insecticides will control the beech scale but their use is considered practical only on ornamental and shade trees. The control value of the fungus, *Gonatorrhodiella highlei* A. L. Smith, often associated with and believed to be parasitic on the *Nectria* fungus (Ayers, T. T. Mycologia 33: 178-187, 1941.), is not clear. Silvicultural treatments, which help to reduce tree injury and mortality, include: (1) the removal of severely infested trees in the early stages of an outbreak; (2) the removal of the larger trees and those on steep slopes which, according to Ehrlich, are the most susceptible; and (3) thinning to reduce the proportion of beech and to maintain stand vigor.

The beech scale and *Nectria* in North America have caused serious economic losses not only in killing trees but in reducing the merchantability of survivors. As these organisms spread in other areas where the host is plentiful and the climate suitable, severe injury and death of many beech trees can be expected.—R. S. Forbes, G. L. Stone, and G. V. Moran.



DISTRIBUTION OF BEECH BARK DISEASE
IN NORTHERN NEW BRUNSWICK

BEECH SCALE TO 1948 - - - - - - -
" " TO 1964 •
BEECH SCALE AND NECTRIA TO 1964 Δ

QUEBEC

Infection Courts of Fungi Associated with Trunk Decay in Black Spruce.—During 1963 and 1964, 190 black spruce (*Picea mariana* (Mill.) BSP.) with visible trunk defects were felled in the central part of Laurentide Park to investigate the infection courts of fungi causing decay. The following possible infection courts occurring on stems were studied critically: 80 broken tops, 43 felling scars, 26 axe blazes, 90 branch stubs, and 63 others. Comparative studies were also carried out on infection courts occurring on branches. Dissection of the selected trees revealed that 82% of those with visible trunk injuries contained decay suggesting that external defects on living black spruce are of practical value as indicators of decay. Frost cracks, twin leaders, animal feeding scars, and cankers proved to be of least importance as infection courts for decay organisms.

Fomes pini (Brot. ex Fr.) Karst. and *Stereum sanguinolentum* (Alb. & Schw. ex Fr.) Fr. were by far the most common of the decay fungi isolated since they were found in 73 and 50 separate infections respectively. *Peniophora septentrionalis* Laurila ranked third with 19 separate infections. With the exception of *Lenzites saepiaria* (Wulf. ex Fr.) Fr., which occurred only in stems, the same decay fungi were isolated from branch injuries. Among the non-decay fungi, *Retinocyclus abietis* (Crouan) Groves and Wells, and *Coryne sarcoides* (Jacq. ex Fr.) Tul. were most frequent. The former, known to be a resin-inhabiting fungus, was found associated with all types of injuries in black spruce. The latter occurred three times more frequently in stems than in branches. *Monilia geophyla* Oud. and *Cytospora* sp. occurred mainly in the vicinity of superficial wounds in the sapwood. *Kirschsteiniella thujina* (Peck) Pomerleau & Etheridge, previously reported as the cause of a blue stain of balsam fir (*Abies balsamea* (L.) Mill.) and eastern white cedar (*Thuja occidentalis* L.) (Pomerleau, Rene, and D. E. Etheridge. Mycologia 53: 155-170. 1961), is recorded apparently for the first time in black spruce.

During a general survey in the same area of Laurentide Park, 696 visible trunk injuries on black spruce were recorded as follows: 197 broken tops, 133 felling scars, 118 twin leaders, 116 animal feeding scars and cankers, 38 axe blazes, and 94 other injuries. Broken tops, which resulted mainly from ice storms and logging operations, were the most common injuries encountered. In the dissection study, infection courts of most of the decay fungi were traced to broken tops; 40% of the total number of infections by *F. pini* and 56% by *S. sanguinolentum* entered through this type of wound. Therefore, in addition to their high frequency of occurrence, broken tops seem to favour infection more than any other type of injury. Among felling scars, which were second in importance as infection courts of most of the fungi isolated, only deep wounds provided suitable entry points for decay fungi. Branch stubs and axe blazes ranked third in importance as infection courts of *F. pini*. Most of the stubs and injured branches which resulted in trunk infections were more than 1.5 inches in diameter suggesting that branch size might have influenced the chances of infection.

The age of the injuries infected by *F. pini* ranged between 3 and 34 years; most of them varied between 5 and 20 years. Although *S. sanguinolentum* was most commonly isolated from injuries of 4 to 13 years of age, it occurred also in 1- to 2-year-old injuries suggesting that this fungus is an earlier invader than *F. pini*. Dissected felling scars were between 10 and 34 years old, whereas the age of broken tops and axe blazes ranged between 5 and 12 years. Felling scars, being more superficial than broken tops, did not cause exposure of the wood to the same degree and this might explain the relatively low percentage infected by *S. sanguinolentum* (9%) as compared to *F. pini* (33%). In drastic wood exposures caused by broken tops and axe blazes the percentage of injuries infected by *F. pini* and *S. sanguinolentum* was between 30 and 36%.

In 29 top-damaged trees, the average rate of linear extension of decay caused by *F. pini* was calculated to be 0.43 ft./yr. Decay was noticeably more important when the breaks occurred at points on the trunks where the diameter was over 3.0 inches than where the diameter was less than 3.0 inches. The rate of extension of decay associated with felling scars and axe blazes is less reliable because of the smaller sample and of the difficulty in determining the exact point of entry. No marked difference was found between the upward and downward extension of decay although the downward extension was slightly greater. Ten separate infections of *S. sanguinolentum* entering from broken tops gave an average rate of extension of 0.31 ft./yr.

Results of these studies indicate that broken tops and other injuries to the stem are more important infection courts than branch stubs which are of a relatively small diameter in black spruce. Possibly higher moisture in broken tops might explain the greater frequency of occurrence of fungi in such injuries. The age and size of the wounds infected by *F. pini* indicates that aging may be one of the main factors involved in the infection process, especially when it determines the competitive action between other colonizing organisms and *F. pini*.—André Lavallée.

ONTARIO

Selectivity of Four Antifungal Chemicals.—Trichlorodinitrobenzene, endomycin, the experimental antibiotic GS-388 and the experimental organic fungicide HRS-1590 were obtained from Chemagro Corp., Upjohn Chemical Co., Chas. Pfizer Co. and Hooker Chemical Corp., respectively, and tested for selective toxicity among 41 strains or species representing actinomycetes, bacteria, and various groups of fungi. The tests were a continuation of an earlier study with a large number of chemicals (Vaartaja, O. Phytopathology 50: 870-873, 1960). Since that study was made, several new chemicals have become available and the four chemicals listed were found particularly interesting and were selected for testing. Each was suspended in a cooled (50°C) molten agar (1:1:1 mixture of plain agar, cornmeal agar, and malt agar) at 5, 10, 20, 50, 100, 200, and 500 ppm. Forty-one organisms isolated from nursery soils, seedling roots, wood, or fruiting bodies (Table 1) were inoculated in petri dishes containing these media. Together with control dishes without chemicals, incubation of isolates was at about 20°C.

Table 1 shows the organisms tested and the results. To illustrate the heterogenity in the commonly used group of *Rhizoctonia*, the name of this genus was used in the table although the perfect stages of several isolates tested were known. In contrast to earlier results with pentachloronitrobenzene, trichlorodinitrobenzene showed little selectivity, being tolerated at high concentrations only by some bacteria and *Streptomyces*. Its general potency against most fungi groups suggests its possible value in controlling many plant diseases. (This as well as the other three chemicals showed no or only slight phytotoxicity when seeds of *Pinus resinosa*

TABLE 1

The lowest inhibitory concentration (in ppm) of 4 chemicals to 41 organisms.

Organism (and No.)		Trichlorodinitrobenzene	Endomycin	GS-388	HRS-1590
(A) Bacteria	(1769)	50	>500t	50	>500
	(7216)	(100)	>500t	200t	>500
	(7228)	500t	>500t	50	>500
(B) *Streptomyces*	(7195)	20	50	>500t	>500
	(7218)	500t	500t	(50)	>500
(C) *T. viride*		(20)	(50)	(200)t	>500
Penicillium sp. & *G. roseum*		<5i	(50)	(20)	>500
Verticillium sp.		(50	(100)	(50)	>500
C. radicicola		(100)t	5i	(20)	>500
F. solani		20	(100)	(>500)t	>500
(D) *Phoma* sp.		(50)	(20)	(20)	>500
(E) *Chaetomium* sp.		10	5i	(20)	>500
(F) *R. hiemalis*		10	5i	5i	>500
(G) and (H) *R. endophytica*		<5i	20	<5i	>500
R. dichotoma & *R. praticola*		<5i	(50)	(50)	>500
R. solani & *W. circinata*		(50)	(20)	20	>500
R. globularis		5i	(50)	(10)	>500
Amylostereum sp.		(50)	(50)	(50)	>500
S. granulatus		<5i	200t	<5i	>500
F. annosus		(10)	(50)	10	>500
A. mellea		<5i	(50)	10	>500
(I) *P. debaryanum*		<5i	(>500)t	<5i	<5i
P. irregulare	(7188)	<5i	(200)t	<5i	50i
P. irregulare	(7141)	(50)	(>500)t	<5i	(10)i
Pythium sp.	(7231)	(50)	(>500)t	<5i	(10)i
P. oligandrum & *P. acanthicum*		<5i	100	<5i	(10)i
P. ultimum	(7204)	(20)	200t	10	(10)i
Pythium sp. & *P. ultimum*	(7202)	10	(500)t	<5i	20i
(J) *Mortierella* sp.	(7184)	<5i	200t	(20)	>500
	(7192)	(10)	(20)	(20)	>500
	(7196)	<5i	(10)	10	>500
	(7199)	<5i	(20)	<5i	(>500)i
	(7203)	(20)	(200)t	20	>500
	(7235)	<5i	(100)	20	>500
Rhizopus sp.	(7207)	20	(50)	20	>500
	(7222)	(50)	(100)	20	>500

( )—parentheses enclose values of full inhibition whenever lower concentrations were partially (>50% inhibitive. In many of such cases the inhibitory limit may have been closer to the next lower concentration tested rather than the one given.
i—unusual inhibition
t—unusual tolerance
>(or<)—more than (or less than) the value given.

Ait. were germinated in dishes with 100 ppm of these chemicals). Similarly, GS-388 appears promising in controlling fungal diseases. HRS-1590 showed very specific activity against only *Pythium* spp. Such specific activity might be useful in certain soils as it does not prevent the natural control exerted by soil flora through antagonism to *Pythium* spp.

Unusual tolerance is an important characteristic when chemicals are used as a research tool, e.g., in assessing incidences of certain groups of organisms in soil. Together with many other polyenes, endomycine was tolerated particularly by *Pythium* sp., bacteria, and certain species of *Mortierella*. As a check, another polyene studied earlier, pimaricin, was tested again against all the fungi of Table 1. The results were generally very similar to those with endomycin. Accordingly, pimaricin was successfully used in surveys of soil *Pythium*. *Fusarium solani* was unusually tolerant of GS-388. Isolation of this fungus was greatly facilitated in soil platings where this antibiotic was incorporated at 25 ppm in corn-meal agar together with 10 ppm each of neomycin and aureomycin against bacteria and 150 ppm of pentacloronitrobenzene against *Trichoderma*. Perhaps the partial tolerance of *Cylindrocarpon radicicola* to trichlorodinitrobenzene could be similarly used in studies of this fungus in soil. The tolerance of *Suillus granulatus* to endomycin suggests that this antibiotic (in combination with others) may be useful in isolations of some basidiomycetes. The important element of soil flora belonging to *Mortierella* spp. might be isolated with the following medium: HRS-1590 at 50 ppm to suppress *Pythium*, endomycin at 50 ppm to suppress most other fungi, and antibacterials to suppress bacteria.—O. Vaartaja.

PRAIRIE PROVINCES

Inoculation Tests with Diplodia tumefaciens (Shear) Zalasky.—Two sets of inoculations were made with *Diplodia tumefaciens* on suckers of poplar maintained in a greenhouse. In one set, eight hybrids were tested for susceptibility to *D. tumefaciens* and, in the other set, black poplar (*Populus balsamifera* L.) and aspen (*P. tremuloides* Michx.) were inoculated to discover whether *D. tumefaciens* from black poplar is equally pathogenic on aspen and vice versa. The host material consisted of 1-year-old aspen and black poplar and 3-month-old hybrid poplars raised in a greenhouse from rooted cuttings. Rooted hybrid cuttings were obtained from the Prairie Farm Rehabilitation Act Tree Nursery at Indian Head, Saskatchewan. Two inoculum sources from aspen (Nos. 51 and 53 from Pineland Nursery, Manitoba) and one from black poplar (No. 69 from Beaver Creek, Saskatchewan) were used. Inoculum was obtained from trees in mixed stands of aspen-black poplar, but only inoculum No. 51 was from a stand in which both species were infected. The funnel method of inoculation was used (Zalasky, H. Can. J. Botany 42, 385-391, 1964).

The occurrence of *D. tumefaciens* on two poplar hybrids, Brooks and Lomardy, naturally infected from diseased aspen and black poplar (Zalasky, H. Plant Disease Reporter 49:50, 1965), suggested that other poplar hybrids may be susceptible. In the first set of inoculations, the eight hybrids (*Populus brooks, P. cardeniensis, P. northwest, P. petrowskyana, P. sargentii, P. tristis, P. vernirubens,* and *P. volunteer*) were mostly cultivars from *Populus deltoides, P. laurifolia,* and *P. balsamifera* (Cram, W. H. Forestry Chron. 36: 204-209, 1960; Poplars in Forestry and Land Use, FAO, 511 pages, 1958). In January 1965, one lot of rooted cuttings that had been transplanted three to a flat in November 1964, were inoculated with inoculum No. 69. Two to seven inoculations were made per hybrid, the total number of inoculations for all hybrids being 30. The funnels in the control plants of the other lot contained sterile distilled water.

On March 22, 1965, examination of inoculated material showed that all inoculations in *P. cardeniensis?, P. petrowskyana,* and *P. tristis* were positive, whereas 9 out of 13 inoculations in *P. brooks* and *P. northwest* were failures. Infected stems had excrescences up to 0.5 cm in diameter. On August 9, 1965, woody galls and swellings up to 2.5 cm in diameter were most conspicuous on *P. cardeniensis?* and *P. petrowskyana*. In a few instances where a new branch forked from the stem, basal galls caused that portion of the branch to become dwarfed and finally to die. The bark of some of the galls was pitted and green except for traces of cork up to 1 mm thick containing the mycelium of *D. tumefaciens*. Fruiting bodies of the fungus occurred in all infected material, except *P. cardeniensis?* and *P. petrowskyana* where the cork apparently sloughed off rapidly enough to prevent the fungus from fruiting. These results suggest that the host has a pronounced influence on the morphological development of the fungus. *P. sargentii, P. vernirubens,* and *P. volunteer* appear to be resistant to *D. tumefaciens.*

In the second set of inoculations four aspen and four black poplar were inoculated with inoculum from each source. Distilled water was used on the controls. Eight inoculations were carried out. Eleven months after inoculation small swellings and *D. tumefaciens* fruiting bodies occurred in all aspen test plants. The swellings were several times smaller than those on black poplar. Inoculum No. 69 infected two black poplar; the other inoculum sources did not infect this species. This indicates that *D. tumefaciens* from aspen is not equally pathogenic to black poplar.—Harry Zalasky and O. K. Fenn.

BRITISH COLUMBIA

Further Observations on Pole Blight of White Pine.—Pole blight of western white pine (*Pinus monticola* Dougl.) is thought to have been initiated by a series of dry, hot summers which may have begun as early as 1917 and continued until the mid-1940's. In Idaho, pole blight distribution has been correlated with the occurrence of soils having limited soil moisture storage capacity or recharge potential (Leaphart, C. D. and O. L. Copeland. Soil Sci. Soc. Amer. Proc. 21: 551-554, 1957.) Preliminary analysis of results from a survey of white pine stands in the southern interior of British Columbia indicates that distribution can be correlated additionally with soil fertility and growth rate of trees. The survey also corroborates recovery trends noted previously.

Most of the affected trees examined in British Columbia were on noticeably podzolized soils, characteristic of the Interior Western Hemlock Zone. Pine stands in areas with relatively dry climates near the margin of the Hemlock Zone were rarely affected. The relatively favourable soil fertility of the weakly podzolized soils of these areas may have been more effective in promoting resistance to pole blight than drought was in causing the disease. Pole blight was also rare among pine growing toward the upper altitudinal limit of the species in the transition between the Hemlock Zone and the Engelmann Spruce—Subalpine Fir Zone. Lack of pole blight at high elevations, however, is unlikely to be related to favourable soil fertility because subalpine soils are usually strongly podzolized. Here, amelioration of drought by more frequent showers and longer duration of snow packs than at lower elevations in the Hemlock Zone may have been a factor.

Internodual growth measurements showed that most of the pole-blight-affected white pine examined had made rapid growth during the early pole stage (age 20 to 50 years). Pole blight was uncommon, even on apparently equivalent sites, when stands were densely stocked and the pine had grown slowly during this period. Consequently, a significant characteristic of the sites on which pole blight occurred seems to be their ability, when appropriately stocked, to support rapid growth of pine during the early pole stage in normal and moist years. Such trees might then be especially vulnerable to water shortage during drought years, particularly in soils with limited soil moisture storage capacity. Slow-growing pine in densely stocked stands are probably less prejudiced. The frequency of pole blight among dominant and co-dominant trees being greater than among intermediate and suppressed trees, and the lack of pole blight among slow-growing pine toward the subalpine zone, may be analogous.

The occurrence of callused margins on lesions in all the 40 affected stands examined indicates that recovery from pole blight is widespread. This trend was first noted in the four disease progress and control plots which had been established earlier (Molnar, A. C. and R. G. McMinn. Bi-mon. Progr. Rept. 14(3): 3-4, 1958). Recovery from pole blight is consistent with the hypothesis that adverse weather induced the disease because improvement could be expected when water shortage moderated following resumption of moister climatic conditions in accord with long-term averages. Even in stands in which most of the pine are now dead, callusing of lesions showed that recovery had begun before death occurred. Death in most cases could be attributed to mountain pine beetle infestations. Successful beetle attacks evidently could continue even after recovery had begun. Beyond the range of pole blight, beetle infestations were rare in immature (less than 120 years old) white pine stands.—R. G. McMinn.

Some Results of Artificial Inoculation with Western Hemlock Dwarf Mistletoe Seed.—Seeds of *Arceuthobium campylopodum* Engelm. f. *tsugensis* (Rosend.) Gill with emergent radicles were collected from western hemlock, *Tsuga heterophylla* (Raf.) Sarg., branches during the early spring of 1964 near Cowichan Lake, Vancouver Island. The seeds, disseminated during the fall of 1963, were planted with the aid of lanolin paste on several 5 to 6 year-old potted conifers in the greenhouse in April 1964. Swellings and dwarf mistletoe aerial shoots developed as follows:

Species	Origin	Inoculation date April '64	Swellings observed	Shoots observed
Tsuga heterophylla	South Coastal B.C.	6	July 15, 1965	July 15, 1965
Tsuga heterophylla	South Interior, B.C.	14	Nov. 25, 1964	April 26, 1965
Tsuga heterophylla	South Interior, B.C.	14	Nov. 25, 1964	Feb. 1, 1965
Tsuga heterophylla	South Interior, B.C.	14	Feb. 1, 1965	April 26, 1965
Tsuga heterophylla	South Interior, B.C.	14	Feb. 1, 1965	April 26, 1965
Tsuga heterophylla	South Interior, B.C.	14	April 26, 1965	April 26, 1965
Tsuga heterophylla	South Interior, B.C.	14	July 15, 1965	July 15, 1965
Pinus contorta	Montana	28	Nov. 25, 1964	Nov. 25, 1964
Picea glauca	Central B.C.	28	Feb. 1, 1965	July 15, 1965
Picea abies	Europe	6	Nov. 25, 1964	Oct. 6, 1965
			Feb. 1, 1965	Oct. 6, 1965

Earliest shoot emergence occurred in lodgepole pine, *Pinus contorta* Dougl. In this case a shoot 3 mm long was observed only 7 months after inoculation, or about 1 year after seed dissemination. Most initial shoots appeared within 3 mm of the original point of penetration. By October 6, 1965, swelling lengths averaged 35 mm (24-45), and widths 6 mm (4-9). The longest shoots at this time were 8 mm. Premature death of several shoots appeared to be associated with insect feeding and resin exudation.

The infection of lodgepole pine by *A. campoylopodum f. tsugensis* was expected as this combination occurs commonly in nature. Establishment of western hemlock dwarf mistletoe on white spruce, *Picea glauca* (Moench) Voss, and Norway spruce, *Picea abies* (L.) Karst., however, constitutes new records and further demonstrates the absence of strict host specificity in this forma.

Although dwarf mistletoe on both western and mountain hemlock, *Tsuga mertensiana* (Bong.) Carr., has been reported from Idaho (Weir, J. R. Bot. Gaz. 66: 1-31. 1918; Graham D. P. I.M.F.R.E.S. Res. Note 68. 1959), no collections have been made in Interior B.C. on either species (Kuijt, Job. Nat. Museum Canada Bul. 186: 134-148. 1963). The successful infection of western hemlock from the Interior indicates that this apparent lack of dwarf mistletoe on Interior hemlock is not due to any inherent resistance. Care must therefore be taken to prevent introduction of western hemlock dwarf mistletoe into the Interior, and to continue efforts to detect any infection centres that may already be established.—R. B. Smith.

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O. H. M. S.

DOUGLAS C. EIDT,
FOREST ENT. & PATH LAB.,
CANADA DEPT. OF FORESTRY, (3-6)
COLLEGE HILL,
FREDERICTON, N.B. L-205

DEPARTMENT OF FORESTRY
OTTAWA