5/16-inch plywood (36 x 48 inches) in locations similar to the position of the bolts which were set in the platform. To accommodate 1-liter Erlenmeyer flasks, holes slightly smaller than the bottom diameter of the flasks were cut in the 5/16-inch plywood sheet in such a manner that the holes were evenly spaced about 1 inch apart. This procedure resulted in the 5/16-inch plywood sheet having 48 holes each with a diameter of 4¾ inches. The platform could accommodate 48 one-liter Erlenmeyer flasks held in position by the 5/16-inch sheet of plywood which was lowered over the flasks and bolts and made fast by affixing wing nuts to the bolts. The variation in the diameter amongst 48 flasks could be disregarded because the plastic foam ensured a snug fit by exerting an upward force upon the bottom of each flask. For our purposes, each flask contained 600 ml of liquid culture making an initial workload of about 125 lbs. (46.6 kg) counting the glassware, platform, and other appurtenances.

In addition, 26 spring steel clamps (125-ml flask size) were removed from the original platform and attached to the 5/16-inch sheet of plywood between the holes which held the flasks in place. This enabled small scale fermentation experiments to be conducted without interrupting large scale production of fungal metabolites (Fig. 1).

Figure 1. New Brunswick Gyratory Shaker (Model G10) with a platform installed to accommodate a workload of more than double that possible on commercially available equipment.

The alterations described can be effected without changing the variable pitch pulley used in machines sold before 1970. However, it is strongly recommended that the pulley be replaced if one speed is desired during the course of the fermentation period. It was found that the additional workload caused abnormal wear of the belts and resulted in increased speed of the shakers when the variable pitch pulley was used. However, belt wear was practically eliminated and a constant speed of about 150 strokes per minute was maintained by replacing the variable pitch pulley with a 1-inch steel pulley. Other size pulleys may be used to achieve different but constant speeds.

A variety of other flasks and containers can easily be accommodated on these platforms by fashioning additional holding covers from 5/16-inch plywood. It is also possible to tilt the flasks by inserting strips of wood on the surface of the platform. This tends to shorten the fermentation period by promoting aeration.

The total cost (labour and materials) of modifying the four machines was about $100.00. The workload was doubled at the expense of a slight increase in floor space. To do the same amount of work with conventional equipment would have required the purchase of four additional machines (Model G10) which in addition to cost would have created a space problem.

One might even substantially increase the workload beyond what is described here. Preliminary investigation in this direction has shown that this could only be accomplished by increasing the size of the platform. Addition of a second platform above caused serious vibration and would probably have resulted in damage to the motor and mechanical apparatus.

Our machines were modified as described above over 1 year ago. They have since been operating continuously at a speed of about 150 strokes per minute with maximum loads and minimal maintenance costs.

The New Brunswick Scientific Co. Inc. are aware of this modification to the machine and further information may be obtained from them. — M.A. Stillwell, Maritimes Forest Research Centre, Fredericton, N.B.

***Kabatina thujae* on Yellow Cedar in British Columbia Nurseries.**—Severe dieback on young ornamental yellow cedars [*Chamaecyparis nootkatensis* (D. Don) Spach] occurred in several nurseries in the Fraser valley in the summer of 1969. The apparent cause of the disease was *Kabatina thujae* Schneider & Arx (Phytopath. Z. **57**:176-182, 1966), which fruited in freshly killed shoots. The fungus was recently reported as the cause of a similar disease of *Thuja, Chamaecyparis* and *Cupressus* in Europe (Morelet, Soc. Linn. Lyon **39**:213-216, 1970). While other fungi have been reported in the Fraser valley outbreak by Plant Protection Division inspectors, *viz. Phomopsis juniperovora,* the finding of *Kabatina thujae* is a new record for North America and of interest because of its occurrence on an important native species. The fungus is also a potential threat to ornamental Cupressaceae in Canada.

The diseased trees, grown from cuttings of a mother tree of the blue form (*glauca* cultivar) of yellow cedar imported from Holland, were 7 years old and approximately 6 to 8 ft high in 1969. They were planted in rich agricultural soil at Pitt Meadows, adjacent to rows of the drooping form (*pendula* cultivar) of yellow cedar. None of the latter was diseased except for a few branchlets in which *K. thujae* was found. In a nursery approximately 30 miles away, a few trees of the *lutea* cultivar were lightly infected.

The dieback affected mostly branch tips and new shoots and was particularly severe in the upper part of the tree. The bole and thick branches were not affected by dieback although cankers were formed at the base of infected branchlets arising from them. Vigorous adventitious shoots grew abundantly around the base of infected trees and these usually became infected. In the nurseries, all trees of the *glauca* cultivar were infected; most had 40 to 50% of shoots and branch tips browned by the disease.

The cankers that formed on the main branches usually did not girdle or spread extensively. Most appeared to be annual, with sloughing of killed bark and extensive healing of the lesion in the same year.

The disease was first reported and studied in August 1969, but, according to the nursery manager, there had been some dieback from the time of outplanting. It is not known whether *K. thujae* was associated with the early disease manifestations. Predisposition to the severe attack in 1969 could have come from extreme low temperatures of the previous winter. Although little is known of the ecology of the *glauca* cultivar, trees would be subject to greater water stress in the Fraser valley than in the usual habitat of yellow cedar.

Differential susceptibility of the varieties of yellow cedar is demonstrated by the almost total absence of damage to the *pendula* cultivar growing on the same site. It is possible that the wild form is completely resistant to *K. thujae*. There has been no opportunity to test pathogenicity of this fungus on the *glauca* cultivar, but its close association with the disease and the known pathogenicity to species of *Thuja* and *Cupressus* are taken as evidence, not proof, of its causal role in this dieback. Pathogenicity tests on potted wildlings of yellow cedar at Victoria were negative.

The acervuli of *K. thujae* were found on dead leaves and branches of yellow cedar but other fungi were also found. *Pestalotia funerea* Desm., a fungus of doubtful pathogenicity, was quite common. An unidentified *Cucurbitaria* sp. was occasionally mixed with *K. thujae*. Two branches were apparently killed by *Cytospora abietis* Sacc., a facultative parasite, indicating perhaps a weaking of the host by climatic conditions.

It is not known if *Kabatina thujae* is introduced, or native, to Canada. The simultaneous occurrence of outbreaks in Canada and Europe makes this a difficult question because definite precedence cannot be established. In the Fraser valley, simultaneous outbreaks occurred at several widely separated points, suggesting that some form of predisposition triggered the outbreak of the already present disease. A survey of this area indicates that none of the native, naturally growing Cupressaceae are infected by *Kabatina*.

We thank Dr. J. A. von Arx, Centraalbureau voor Schimmelcultures, Baarn, for confirming identification of the fungus.—
A. Funk and A. C. Molnar, Pacific Forest Research Centre, Victoria, B.C.

Infection of Amabilis Fir by Larch Dwarf Mistletoe.—In nature, larch dwarf mistletoe [*Arceuthobium laricis* (Piper) St. John] occasionally attacks alpine fir [*Abies lasiocarpa* (Hook.) Nutt.] and grand fir [*A. grandis* (Dougl.) Lindl.] and, as our host-specificity studies show, it can also infect amabilis fir [*A. amabilis* (Dougl.) Forbes].

Larch dwarf mistletoe seeds were collected each year in September from southeastern British Columbia and stored in petri dishes at 5 C until used in inoculations in late October. Over a period of 4 years, 144 seeds were planted on eight amabilis fir growing in a plantation at Victoria, B.C. Seeds were wetted briefly and placed singly at the bases of needles and buds on 1- and 2-year-old branches.

A single, successful infection was first observed early in the third year after inoculation as a branch swelling with 14 small dwarf mistletoe aerial shoots. Several of these shoots produced female flowers in the fourth year, but all shoots were dead by the fifth, thus preventing development of fruit. The maximum height attained by the aerial shoots was 15 mm. The infection, still alive at the end of the fifth year after inoculation, had not produced any new aerial shoots. By this time, the swelling was 70 mm long and 19 mm wide.

Because the ranges of amabilis fir and western larch [*Larix occidentalis* Nutt.] do not coincide in British Columbia, this host-parasite combinttion will not occur naturally here. However, despite the low rate of infection indicated in the trials, the combination might be found in nature in the United States, since there is considerable overlap of the ranges of amabilis fir and western larch, particularly in Washington (Collingwood and Brush, Knowing your trees, Amer. Forest Ass., 1964). In the Mt. Adams area of south-central Washington and in north-central Oregon, the two species are reported as constituents of the same *Abies amabilis* zone (Franklin and Dyrness, U.S.D.A., Forest Serv., Res. Pap. PNW 80, 1969). Furthermore, larch dwarf mistletoe has been reported from these same general areas (Gill, Trans. Conn. Acad. Arts and Sci., 32: 111-245, 1935.)—
R. B. Smith and E. F. Wass, Pacific Forest Research Centre, Victoria, B.C.

Relative Susceptibility of Coastal and Interior Western Hemlock to Hemlock Dwarf Mistletoe *(Arceuthobium tsugense)*.—Hemlock dwarf mistletoe [*Arceuthobium tsugense* (Rosend.) G. N. Jones] is restricted to coastal western North American forests. In British Columbia, it has been recorded up to 120 miles inland along main east-west valleys. Its principal host, western hemlock [*Tsuga heterophylla* (Raf.) Sarg.], has a much wider distribution and is found commonly in southeastern British Columbia in the Interior Western Hemlock Zone (Krajina, Ecol. West. Nor. Amer. 2(1):1-147, 1969), eastern Washington, northern Idaho and northwestern Montana. The reasons for the lack of hemlock dwarf mistletoe in interior areas has never been fully explored, though it has been demonstrated that western hemlock from southeastern British Columbia is not immune (Smith, Can. Dep. For., Bi.-Mon. Prog. Rpt. 21(6):3-4, 1965). As these early tests were not designed to discover whether differences in degree of susceptibility existed between interior and costal provenances of western hemlock (hereafter referred to as "interior hemlock" and "coastal hemlock", respectively), a new experiment was initiated.

Hemlock mistletoe seeds were obtained in early March 1968, by collecting seeds, already dispersed and germinating, from hemlock trees in a severely infected young stand near Cowichan Lake, Vancouver Island. Small twigs with seeds adhering to the needles and bark were clipped off, soaked in water, and the seeds gently removed with forceps. Since the seeds were no longer naturally sticky, inoculations were conducted by smearing a small amount of lanolin paste on twigs near needles. Seeds were placed singly on the paste with the radicles pointed toward the needle bases. In this manner, 12 seeds were planted on each of 15 interior hemlock and 15 coastal hemlock trees growing in pots in a greenhouse compartment. Temperatures within the compartment were kept as near as possible to the outside ambient temperatures. To reduce water loss from the seeds, the trees were given a water-mist treatment once a day during the first spring and summer. In nature, this moisture is provided by rain and dew. After 2 years, the potted trees were placed in an unheated shade-house.

Forty-three infections were produced on coastal hemlock and 40 on interior hemlock. One of the coastal hemlock trees died before infection could take place; thus, the inoculum was reduced from 180 to 168 seeds. By using this modified number of seeds for coastal hemlock, the rates of infection were 25.6% on coastal and 22.2% on interior hemlock. The only marked difference in host response was a more rapid development of symptoms and signs on interior hemlock than on coastal hemlock. During the first year after inoculation, swellings on interior hemlock were observed in 13 infections, during the second year, in the remaining 27. In contrast, only two swellings appeared on coastal hemlock during the first year, 35 during the second and six in the third year. Similarly, aerial shoots were slower to emerge from infections on coastal than on interior hemlock; 39 infections on interior hemlock and 17 on coastal hemlock bore aerial shoots in the second year. On all infections, shoots emerged by the end of the third year after inoculation.

The relatively advanced development on interior hemlock was short-lived. By the end of the fourth year, swellings on both provenances averaged 11.0 cm in length, and the average number and maximum height of aerial shoots differed only slightly. However, the earlier initial emergence of shoots on interior hemlock may have been the cause of the larger first fruit crop (500 per fruit-bearing infection) than that produced on the coastal hemlock (178 per fruit-bearing infection). Knowing that in other respects infections on coastal hemlock eventually equalled those on interior hemlock, it is assumed that fruit production would also become comparable in subsequent years.

There are thus no apparent differences in the susceptibility of interior and coastal hemlock to hemlock dwarf mistletoe that can explain the absence of hemlock mistletoe in interior areas. The earlier response to infection of interior hemlock would have, if anything, a favorable effect on the establishment and growth of hemlock mistletoe. Any explanation for the lack of dwarf mistletoe on hemlock in the Interior Western Hemlock Zone must lie, therefore, in present biological, geographic or climatic barriers, in historical events, or in some combination of these