the predicted growth to be inversely related to the initial number of trees, as follows:

$$\triangle d_g = d_{g_2} \rightarrow d_{g_1} = b_1 \sqrt[4]{(h_{L_2}T_2 - h_{L_1}T_1)/N_1} \qquad \text{V}$$

Subsequent investigation indicated that since the data, "Evert, *loc. cit.*", involving the combined variable $\sqrt[4]{h_L T/N}$ came from a single site, stand age could be substituted for Lorey's height since the two variables are closely correlated because of their close association. This proposition was found to be true following tests using the variable $\sqrt{h_L}/\sqrt[4]{N}$ with the previous data; the same variable with the black spruce data, however, still gave a poorer fit than previously obtained with Equation III ($r^2 = 0.89$ *vs* $R^2 = 0.94$).

Further investigation with the black spruce data showed that the relationship of expression $\sqrt{h_L}/\sqrt[8]{N}$, to quadratic mean diameter approximates a straight line (Figure 1), which is described by the following regression:

$$d_g = -2.10 + 2.61\sqrt{h_L}/\sqrt[8]{N} \qquad \text{VI}$$

($r^2 = 0.949$ and standard error of estimate SE = ± 0.31 in.)

For direct computer calculation, Equation I, when substituted with the predicted diameters from Equation VI, becomes

$$\triangle G = N_1 \left\{ -0.0598\,(\sqrt{h_{L_2}} - \sqrt{h_{L_1}})/\sqrt[8]{N_1} + 0.0372(h_{L_2} - h_{L_1})/\sqrt[4]{N_1} \right\} \qquad \text{VII}$$

Equation VII was tested twice, using tallied initial number of trees of the test plots and their measured initial heights, and (i) measured 10-year height increment of test plots, and (ii) estimated 10-year height increment using height/age curves of another study (Evert, Forest Sci. 16(2):183-195, 1970). Measured basal-area growth of the test plots had been determined from discs cut from every tree at dbh.

The results of both tests proved that there was good agreement between the measured and predicted gross basal-area increment by 10-square-foot measured increment classes as well as by overall means. The largest error was 7.7 square feet; most errors are substantially below this figure (Table 2). — F. Evert, Forest Management Institute, Ottawa, Ont.

PATHOLOGY

Douglas-fir, a New Host for Hemlock Dwarf Mistletoe.—Hemlock dwarf mistletoe [*Arceuthobium tsugense* (Rosend.) G.N. Jones], most damaging to western hemlock [*Tsuga heterophylla* (Raf.) Sarg.] and mountain hemlock [*T. mertensiana* (Bong.) Carr.], can parasitize at least 16 other species included in the genera *Tsuga*, *Pinus*, *Picea*, *Abies* and *Larix*. There has been no reported infection of Douglas-fir [*Pseudotsuga menziesii* (Mirb.) Franco] by hemlock dwarf mistletoe, even though Douglas-fir commonly grows in mixture with infected western hemlock trees throughout much of its range in coastal western North America. Douglas-fir has therefore been considered immune to infection by hemlock dwarf mistletoe. This note details the successful infection ot Douglas-fir by hemlock dwarf mistletoe resulting from artificial inoculations.

Hemlock mistletoe seeds were collected in October from western hemlock and lodgepole (shore) pine [*Pinus contorta* Dougl.] on Vancouver Island, British Columbia, by clipping off infections with ripe fruit and discharging the seeds into paper bags. The seeds were transferred to petri dishes and stored at 5 C for 2 to 4 weeks before inoculation, in late October and early November. Inoculations consisted of briefly wetting the seeds and placing them singly at the bases of needles and buds on 1- and 2-year-old branches. Three hundred and twenty seeds from each host were placed on Douglas-fir trees growing in a plantation at Victoria. Half of the trees were the Coastal form of Douglas-fir [var. *menziesii*] and the remainder were the Interior form [var. *glauca*] (Hosie, Native Trees of Canada, Queen's Printer, Ottawa, 1969).

As indicated by branch swellings, six infections were produced, all on the Interior form. Five of the infections resulted from inoculations with hemlock dwarf mistletoe from lodgepole pine, an infection rate of 3.1%. Only one resulted from inoculations with hemlock dwarf mistletoe from western hemlock. For two infections, swellings were first observed in the second year after inoculation; for the others, they were not evident until the third or fourth year. Following the pattern of other less common host-parasite combinations, the swellings were more globose (length: width = 2.5:1) than those associated with normal parasitism of western hemlock by hemlock mistletoe (Smith, Can. Dep. Fish Forest, Bi-Mon. Res. Notes 26(2):14, 1970). The rate of longitudinal enlargement of the swellings was 10 mm per year, considerably less than the rates of 28 and 19 mm per year attained in the same plantation by hemlock dwarf mistletoe on western hemlock and Douglas-fir dwarf mistletoe [*Arceuthobium douglasii* Engelm.] on the Interior form of Douglas-fir, respectively. During the fourth year after inoculation, single aerial shoots emerged from two of the infections. By the end of the fifth year, these two infections each possessed two aerial shoots. The largest shoot (24 mm in height) bore male flowers in the fifth year and anthesis proceeded normally.

The Interior form of Douglas-fir is thus shown to be susceptible to hemlock dwarf mistletoe, while the Coastal form appears immune or, at least, less susceptible. Since the Interior form is not naturally exposed to the disease, and the Coastal form appears to be immune, the absence of records of hemlock dwarf mistletoe on Douglas-fir might thus be explained. However, examination of Douglas-fir trees growing with infected western hemlock would possibly reveal successful parasitism, particularly at the eastern fringe of the range of hemlock mistletoe where Douglas-fir has some characteristics of the Interior form. Detection of natural infection would require very close inspection of branches because of low frequency and small size of infections, scarcity or lack of aerial shoots, and absence of conspicuous host damage. — R.B. Smith and E.F. Wass, Pacific Forest Research Centre, Victoria, B.C.

Simple and Inexpensive Modification for Doubling the Workload of Gyratory Shaking Machines.—Gyratory shakers are frequently used to enhance growth and metabolic processes of micro-organisms in liquid cultures. Several years ago, we were using four machines (New Brunswick Gyrotory Shakers — Model G10) to produce an antifungal metabolite with which we were experimenting. Other workers became interested in our compound and requested samples, thus presenting an immediate problem of production. The purchase of additional machines to resolve this, apparently short-term, problem seemed unduly expensive and their acquisition would have created a serious space problem. Similarly, the cost of modifying our equipment by installing commercially available parts could not be justified since the workload would not have been substantially increased. We therefore decided to attempt modifications of our own. The following is a description of the changes that were made.

The shaker platform (24 x 36 inches) was replaced by a ¾-inch sheet of fir plywood (36 x 48 inches) in which eight carriage bolts (¼ x 4 inches) were set 6 inches in from the edge and spaced 18 inches apart. One additional bolt was set in the center of the platform. The platform was then covered by a 1-inch piece of plastic foam which in turn was covered with polyethylene sheet. Nine holes, ¼ inch in diameter, were also bored in a sheet of