BI-MONTHLY RESEARCH NOTES

IN THIS ISSUE:

Vol. 27—No. 5, SEPTEMBER-OCTOBER, 1971.

Published under the authority of The Minister Department of The Environment Ottawa, Canada

BI-MONTHLY RESEARCH NOTES

A selection of notes on current research conducted by the Canadian Forestry Service, Department of the Environment

BOTANY

An Aberrant Cone in Western Hemlock.—Aberrant cone forms have been reported on several conifer species for more than a century; eleven genera bearing modifications of the proliferated cone form have been listed by Doak (Univ. Illinois Bull. 32(9), 1935). Proliferated cones have been illustrated by, among others, Chamberlain (Gymnosperms, structure and evolution. Chicago Univ. Press. Chicago. 1935). Silen described the phenomenon in Douglas-fir (Ann. Mtg. West. Coord. Comm. pp 12-18, 1967, J. Forest. 65:888-892, 1967). This phenomenon has been observed on more than twenty species. Both ovuliferous and staminate cones proliferate frequently, i.e., change to the vegetative phase, and the proliferating branch may again bear cones (Chamberlain, *loc. cit.*; Silen, J. Forest).

This note illustrates the first reported occurrence of cone proliferation in western hemlock [*Tsuga heterophylla* (Raf.) Sarg.]. Although the phenomenon appears to be fairly common among conifers, proliferated cones are rarely found in large numbers on single trees (the Douglas-fir reported by Looney and Duffield (Forest Sci. 4:154-155, 1958) is an exception). It is conceivable that considerable numbers of proliferated western hemlock cones may be observed in any season but pass unrecognized by most foresters. The cone (Fig. 1) is the first and only aberrant hemlock cone so far observed by the writer. It was found

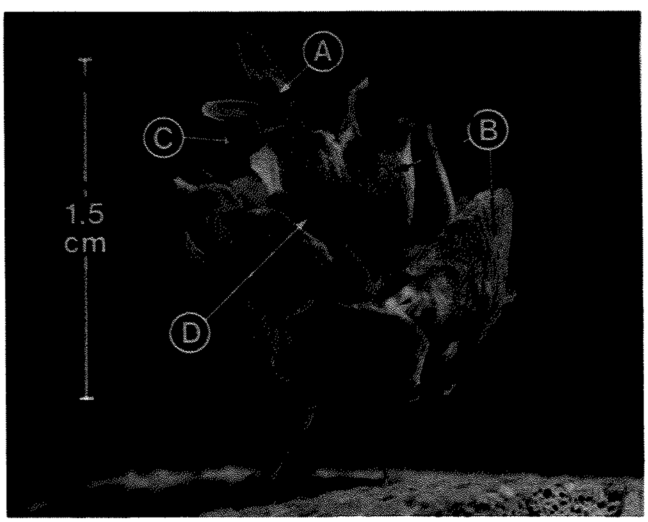

FIGURE 1. Proliferated cone of western hemlock. A—terminal bud; B—cone scales; C—needle; D—seed wing.

on Vancouver Island in 1970 and did not differ greatly from normal cones on the same branchlet, although it was slightly smaller and displayed a striking tuft of foliage at its adaxial end. Most of the needles had been lost at the time the photograph was taken, since the cone has been allowed to air dry to determine its seed content. Thirteen seeds complete with wings were removed; all seeds were empty.

The morphological significance of the phenomenon supports the theory that the conifer cone is a compound strobilus comprising a main axis with secondary fertile short shoots (scales) in the axils of bracts (Owens and Smith, Can. J. Bot. 43:317-332, 1965), and increases speculation that cone (or flower) induction is far from being an all-or-none process. Future cone collections will attempt to secure material of this sort for further study.—D. G. W. Edwards, Pacific Forest Research Centre, Victoria, B.C.

ENTOMOLOGY

Biological Control of Forest Insects in Canada.—The first biological control program involving the introduction of parasites, predators, or pathogens against forest insects in Canada commenced in 1910. From that year to 1958, biological control was attempted against 36 forest pest species, whose ecology was investigated fairly comprehensively. These and similar control programs involving agricultural crop pests conducted during the 48-year period from 1910 were reviewed in 1962 (Tech. Commun. 2. Commonw. Inst. Biol. Cont. 1962. 216 pp). New problems and broadened experience in biological control prompted the Canadian Forestry Service and the Canada Department of Agriculture to prepare a second review covering the decade that terminated in 1968. The second review, recently published (Tech. Commun. 4. Commonw. Inst. Biol. Cont. 1971. 266 pp.), updates some of the earlier biological control programs, discusses new ones, but, unlike the earlier review, attempts to evaluate each program.

The recently published review covers 12 target pests involving the use of parasites, pathogens, and predators. Three of these led to virtually complete control of the target species, two were successful over large areas with occasional local damage, three gave local control with promise of widespread effectiveness as the biotic agent attains wider distribution, two reduced populations but provided only slight control, and two could be classed as failures. Eight of the 12 target pests are generally considered to be of European origin. It is of interest that two of the eight are frequently reported as pests in Europe, one is occasionally reported as a pest, and five are seldom if ever reported as pests in Europe, indicating that the new environment in Canada is more favourable than the original one. Control of the four native pests was negligible to moderate.

Biological control is still not the panacea of all forest insect problems, but its importance will increase as we become more efficient at applying research knowledge on an operational scale. Furthermore, in developing control programs it will always be essential to examine the biological control of each target species in relation to feasibility and cost compared with alternative methods. Although biological control of pests is generally more sociologically acceptable than chemical control, the latter usually has an economic advantage when forest stands have reached a critical stage of infestation.—W. A. Reeks, Canadian Forestry Service, Ottawa, Ont.

Predicting Spruce Budworm Development.—Many investigators have shown that heat units (degree days) accumulated above a known base temperature can be used to predict certain phenological events. Cameron *et al.* (J. Econ. Entomol. 61:857-858, 1968) showed a relationship between heat units and larval development of the spruce budworm [*Choristoneura fumiferana* (Clem.)] using a base temperature of 37 F. This temperature was determined by Bean (Ann. Entomol. Soc. Amer. 54:175-177, 1961) from the field emergence of overwintering larvae. Our laboratory investigations show that 42 F is a more appropriate base temperature for assessing the development of post-diapause budworm and the purpose of this note is to present revised data on larval development using the base of 42 F. In addition, data are presented on adult development in relation to heat units. Both bits of information have proved useful in timing field sampling programs.

We have used the same data as Cameron *et al.* (*loc. cit.*) to determine the relationship of heat units to larval development shown in Table 1. The data are shown separately for two areas of New Brunswick: Green River with a cool continental climate and Fredericton with a warm continental climate. There were no differences in the relationship between the two areas.

TABLE 1

Heat units required for budworm larval development (above 42 F and two sets of data for heat units required for 50% moth emergence (one with and one without an excess heat cut-off)

Developmental stage	Area	
	Green River	Fredericton
Emergence	69	84
Instar III	290	302
Instar IV	431	406
Instar V	557	535
Instar VI	751	740
Pupae	973	961
50% moth emergence		
>42 F	1038 - 1160	1181 - 1352
>42 F & <78 F	992 - 1071	1058 - 1188

Adult development, or the time of emergence of adults, is not easily measured in a field population and we have used the number of moths caught nightly in traps as an index. The moth trap data were gathered between 1960 and 1970. The Green River data are the numbers of males caught on 25 sticky traps baited with virgin females, and the Fredericton data are the numbers of males and females caught in a light trap operated yearly from late May to late October. Although the sampling method differed between the two areas, we suspect that the proportion of females in the light trap was low, and insufficient to cause bias. A light trap was also operated at Green River but the catches were too low in most years to be meaningful. In the analysis, nightly catches were first converted to percentages of the total seasonal catch, accumulated for the season in each area, and then plotted over heat units above 42 F accumulated from April 1. Some of the data were rejected because of extremely low catches, or because a moth invasion had obviously occurred. The final analysis consisted of 6 years' data from the Green River area and 7 from the Fredericton area. The regression of accumulated moth catch over accumulated heat units was determined for each year. It was found that a probit transformation failed to increase the precision of the regression when the first and the last 5% of the moths trapped were excluded from the analyses; consequently the regressions were based on raw counts. The explained variance in the 13 regressions ranged from 83 to 98%.

The regression of moth catches on heat units revealed two unexpected results: (1) significant differences between years within locations, and (2) significant differences between locations. The significant differences between years within locations were quite evident. Thus the Green River data showed 50% moth catch when 1038 heat units had been accumulated in 1966, but not until 1160 units had been accumulated in 1969; the Fredericton data showed 50% moth catch at 1181 heat units in one year and as many as 1352 units in another. The reasons for the differences between years are not clear. Itô and Endo (Jap. J. Ecol. 20:59-62, 1970) observed similar differences in the fall webworm in Japan and surmised that high temperature delayed pupal development and displaced the curve of moth catch over accumulated heat in some years. Morris and Fulton (Mem. Entomol. Soc. Can. 70, 1970) also found significant yearly differences in the curve of moth catch over accumulated heat for the fall webworm at Truro, N.S., but explained the differences through genetic selection for individuals having different heat requirements for development. Excessive heat slows budworm development but there is no evidence yet that excessive heat or genetic selection explains our results. One possible explanation comes from an unpublished report of Miller and McDougall where it was shown that budworm survival increases as the number of days with favorable weather during the critical larval development period increases. The critical period refers to the 50 days after the peak of the third instar and favorable weather refers to days with a maximum temperature greater than 70 F, more than 5 hours sunshine, no rain, and relative humidity less than 50%. Similarly, we found that variation in the amount of heat for 50% adult emergence is related to summer weather with the lowest heat accumulation occurring in a sunny, dry summer. This does not conflict with Shepherd's observation (Can. J. Zool. 36:770-786, 1958) that on bright sunny days the internal temperature of the budworm may average 5 F above ambient temperature. Thus the ambient heat units observed on sunny days would be lower than the heat effectively experienced by the insect and this could explain yearly differences in the relationship of heat units to adult development.

The difference between locations in heat units required for moth emergence was also unexpected, largely because it was not possible to discern similar differences in the larval development data (Table 1). Itô *et al.* (Appl. Entomol. Zool. 5:133-144, 1970) observed place-to-place differences in the heat required for larval development of the fall webworm and suggested industrial air pollution in one area as a cause. One possible explanation of the budworm results is that budworm development was delayed at Fredericton because of high temperature. To test this, new heat unit values were determined (Baskerville and Emin, Ecology 50: 514-517, 1969) on the assumption that budworm development virtually ceases at temperatures above 78 F. The new regression of moth catch on accumulated heat units still showed an earlier development at Green River (Table 1) although the difference narrowed somewhat. This phenomenon requires further research.

Spring emergence of overwintering spruce budworm larvae would be expected at about 75 heat units, the peak of the third instar at about 300, the peak of the sixth instar at about 750, and initial emergence of male adults at about 850 when heat units are accumulated above 42 F. Any significant adult activity before 850 heat units should be treated as potential moth invasion from a warmer area.—C. A. Miller, D. C. Eidt, and G. A. McDougall, Maritimes Forest Research Centre, Fredericton, N.B.

Effects of a synthetic juvenile hormone on the embryonic and postembryonic development of the spruce budworm after application to the eggs.—Several analogues of juvenile hormone (JH) have been shown to effectively block embryonic development in the spruce budworm [*Choristoneura fumiferana* Clem.] when applied to the eggs (Retnakaran, Can. Ent., 102:1592-1596, 1970; Retnakaran and Grisdale, Ann. Entomol. Soc. Amer., 63:907-909, 1970). When applied to some insect eggs, JH analogues can also have latent effects, which become apparent during post-embryonic development (Riddiford and Williams, Proc. Nat. Acad. Sci. U.S., 57:595-601, 1967; Riddiford, Science, 167:287-288, 1970; Willis and Lawrence, Nature, 225:81-83, 1970). In this note, we report the effects of a synthetic JH (JH, AY-22, 342, Ayerst Research Laboratories) on the embryonic and postembryonic development of the spruce budworm after application to the eggs.

Egg masses were collected from mated females, originally taken from an epidemic field population as pupae, and incubated at 21 C and 70% RH. Under these conditions, the eggs hatched in about 9 days. Eggs were treated 1 or 5 days after they were laid by dipping intact masses, still attached to the balsam fir needles on which they were laid, into different concentrations of the JH in acetone for 5 seconds. Controls were dipped in acetone only. After allowing excess acetone to evaporate, each mass was placed in a screw cap glass vial (95 x 25 mm) containing a piece of loosely rolled gauze bandage in which the first instar larvae could spin hibernacula.

Egg hatch and the degree of embryonic development in unhatched eggs was estimated after 14 days of incubation using the techniques described by Eidt and Cameron (Can. Dep. Fish.

Forest., Bi-mon. Res. Notes, 26:46-47, 1970). Unhatched eggs were classified as: Type A—showing little or no apparent embryonic development; Type B—with a small but distinct embryo; and Type C—containing a more or less mature embryo (black head capsule visible).

With minor exceptions, standard spruce budworm rearing procedures (Grisdale, Can. Ent., 102:1111-1117, 1970) were used throughout the development of the postembryonic stages. The vials containing larvae in hibernacula were transferred to cold storage 4 weeks after hatch and held there for 20 weeks. After removal from cold storage, larvae emerging from hibernacula were reared individually through to the adult stage when the experiment was terminated. Mortality was assessed at the end of each stadium and the pupal stage.

The results showed no evidence of the JH having any delayed effects on either embryonic or postembryonic development (Table 1). Treatment of both 1- and 5-day-old eggs with solutions

TABLE I

Effects of JH on embryonic and postembryonic development when applied to eggs.

Treatment, % concn.	Eggs treated	% hatch	% unhatched eggs[a] A	B	C	% postembryonic survival
			1-day-old eggs			
Control[b]	443	88	10	2	0	20
0.01	371	92	7	1	0	26
0.05	450	92	6	<1	1	32
0.1	454	80	12	4	4	22
0.5	428	60	27	11	2	34
1.0	429	4	85	8	3	23
5.0	405	0	98	0	2	—
			5-day-old eggs			
Control[b]	191	68	27	4	1	37
0.01	233	72	23	2	3	21
1.0	179	8	86	4	2	29
10.0	186	0	100	0	0	—

[a] See text for description of unhatched eggs.
[b] Treated with acetone only.

of JH at concentrations of 1% and above resulted in a drastic reduction in hatch. At all concentrations of JH tested, few of the unhatched eggs showed signs of having developed much beyond the stage already reached at the time of treatment.

Survival of the postembryonic stages was low, but there was no evidence to indicate that mortality was a result of earlier treatment with the JH. Most mortality occurred amongst the first and second larval instars; larvae failed to spin hibernacula or else failed to leave the hibernacula after cold storage. Examination of both dead and surviving individuals of all stages revealed no unusual morphological features that could be attributed to delayed morphogenetic activity of the JH.

The gift of JH by Ayerst Research Laboratories, Montreal, P.Q., is gratefully acknowledged—I. Outram and P. M. Nielsen, Maritimes Forest Research Centre, Fredericton, N.B.

MENSURATION

Stem Weight and Volume Distribution in Six Balsam Fir Trees.—Equations describing the distribution of volume over the tree stem were presented by Honer (Forest. Chron. 40(3):324, 1964; Pulp Pap. Mag. Can. 66(11):WR499, 1965), and used for the estimation of merchantable tree volume. In this note, distributions of weight and volume over the tree stem are compared graphically for three, young, open-grown trees and for three, older, forest-grown balsam fir [*Abies balsamea* (L.) Mill.] trees paired by height. The trees were sampled at the Petawawa Forest Experiment Station, Chalk River, Ontario. Their characteristics are given in Table 1.

The trees were severed 0.5 feet above ground, debranched and cut into bolts about 4.0 feet long. For each bolt, end diameters, length, and the fresh weight were recorded. The weight was rounded to the nearest 0.5 lb if the small end diameter was larger than 1 inch, and to the nearest 5 g if it was below 1 inch. A disk about 1.5 inches thick was removed from the mid-portion of each bolt. Disks were taken to the laboratory in plastic bags for determination of fresh and oven-dry (o.d.) weight. In determining the o.d. weight, disks were kept at 104°C until no change in sample weight was noted. All the disk weights were estimated to the nearest 0.1 g.

TABLE 1

Characteristics of the balsam fir sample trees.

Tree No.	Age at stump (yr.)	Dbh o.b. (in.)	Height (ft)	Total fresh stem weight (wood and bark) (lb.)	Total fresh stem weight (wood) (lb.)	Total o.d. stem weight (wood) (lb.)	Total i.b. stem volume (cu ft)
				Open-grown trees			
76	36	9.5	40.4	379.4	295.1	134.9	7.9
79	39	11.8	53.3	1124.0	993.1	359.3	17.4
60	42	15.7	63.1	1816.9	1608.1	635.4	29.3
				Forest-grown trees			
107	61	4.7	40.4	113.1	98.6	37.9	2.0
126	53	7.8	53.4	431.7	377.2	153.2	7.5
115	62	9.3	63.4	722.1	638.3	271.8	13.3

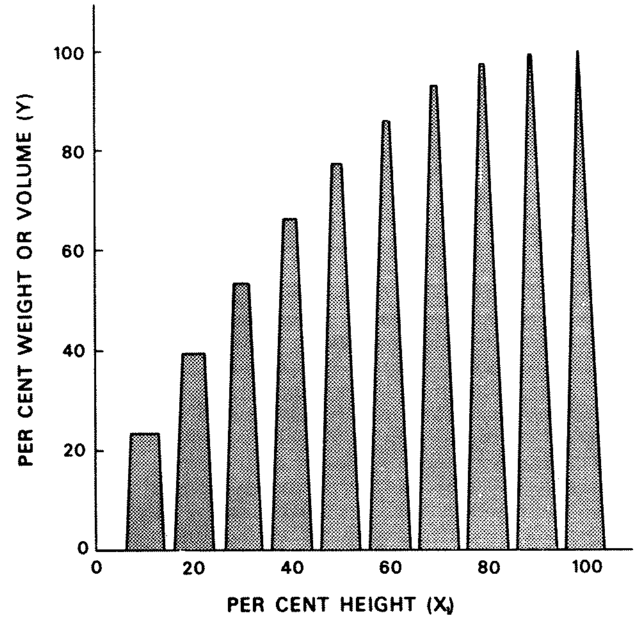

FIGURE 1. Stem weight, or volume, distribution.

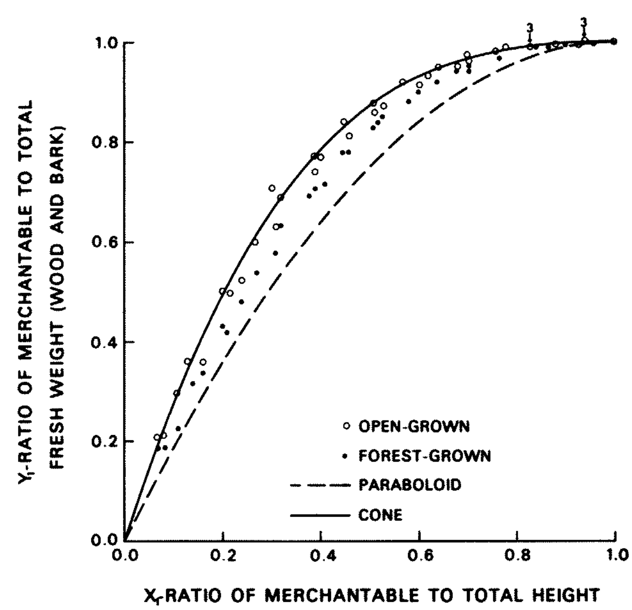

FIGURE 2. A comparison of fresh weight distribution, wood and bark, in open- and forest-grown balsam fir trees with volume distribution in geometric solids.

The inside bark (i.b.) volume of bolts was obtained by using the Smalian formula. Stumps were considered as cylinders 0.5 feet high with diameter equal to the large-end i.b. diameter of the lowermost bolt.

For each bolt, the fresh and o.d. weight of wood without bark was calculated using the fresh bolt weight and appropriate disk weight ratios. The fresh, and o.d. stump weights were obtained from the corresponding weights of the lowermost bolt and of stump volume.

Figure 1 illustrates the distribution of volume over the tree stem and shows how the dependent (Y_i) and independent (X_l) variables are determined. Y_i is the ratio of merchantable to total weight, or of merchantable to total volume corresponding to the independent variable X_l, the ratio of merchantable to total height. The Y_i-ratios were as follows:

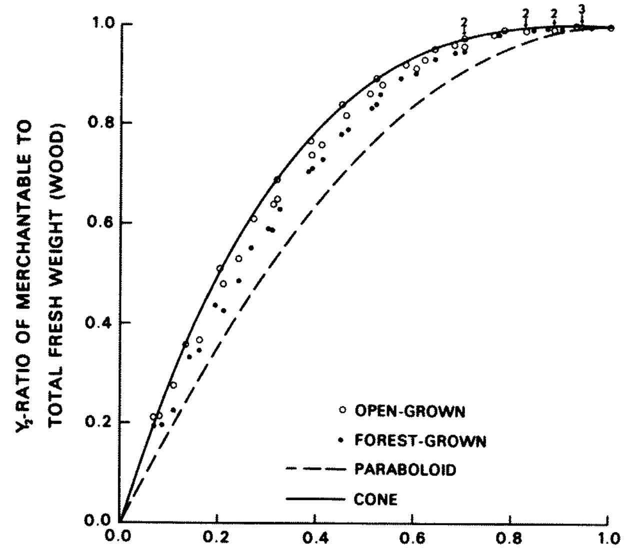

FIGURE 3. A comparison of fresh weight distribution, wood only, in open- and forest-grown balsam fir trees with volume distribution in geometric solids.

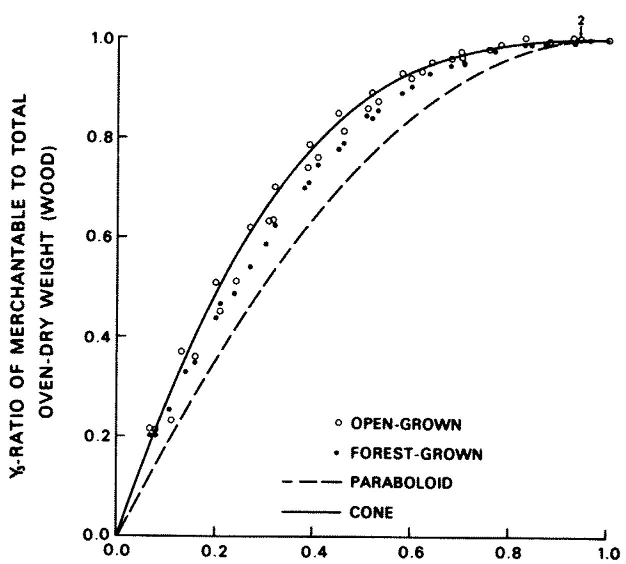

FIGURE 4. A comparison of dry weight distribution, wood only, in open- and forest-grown balsam fir trees with volume distribution in geometric solids.

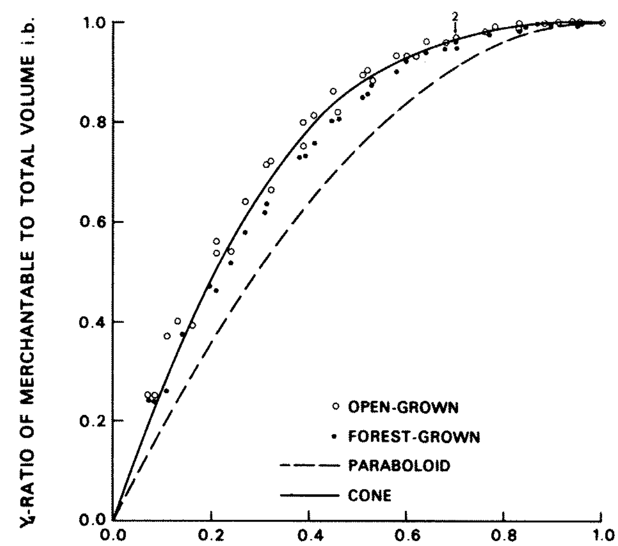

FIGURE 5. A comparison of volume distribution in open- and forest-grown balsam fir trees with volume distribution in geometric solids.

Y_1—ratio of merchantable to total fresh weight (wood and bark)
Y_2—ratio of merchantable to total fresh weight (wood)
Y_3—ratio of merchantable to total o.d. weight (wood)
Y_4—ratio of merchantable to total volume, i.b.

The scattergrams in Fig. 2 - 4 show the weight distribution over stems of the open-grown and forest-grown trees. The curves in Figs. 2 - 4 show the volume distribution for ideal geometric solids, *i.e.*, for cones and quadratic paraboloids. Scattergrams in Figs. 5 show the volume distribution for trees and solids.

Figures 2 - 5 indicate that (i) the method (Model 1—Height Ratio. Pulp. Pap. Mag. Can., *loc. cit.*) used by Honer in development of volume distribution equations can be used in developing the weight distribution equations; (ii) the weight distributing for open-grown trees can be approximated by the equation describing the volume distribution in ideal cones; (iii) the weight distribution for forest-grown trees cannot be approximated by the latter equation, nor can it be approximated by the equation describing the volume distribution in quadratic paraboloids; (iv) the regression equation,

$$Y_i = a_i + b_iX_l + c_iX_l^2$$

may be a satisfactory means of estimating the fresh or o.d. weight of the merchantable stem, with or without the bark, if the total stem weight is known.—T. G. Honer and L. Heger, Forest Management Institute, Ottawa.

Errata: Vol. 27, No. 4, pp 30-31

p. 30, col. 2, line 14 under mensuration; read "Svenska Skogsvårdsföreningens Tidskrift, häfte . . ."

p. 30, col. 2, line 28 under mensuration; read "The predicted basal area growth (increase) . . ."

p. 30, col. 1, line 3 under Figure 2; read ". . . Norske Skogforsøks-"

p. 30, col. 1, line 4 under Figure 2; read "vesen, . . ."

p. 30, col. 1, the following table should be included:

TABLE 1

Measured stand and predicted diameters

Plot No.	Measured stand					Predicted diameter	
	Age (yrs)	h_L (m)	N (/ha)	d_g (cm)	Δd_g (cm)	d_g (cm)	Δd_g (cm)
24	53	19.9	1,320	19.5		20.7	
	63	22.4	520	26.7	7.2	28.6	7.9
25	54	17.7	1,515	17.3		19.5	
	73	24.7	531	27.3	10.0	30.1	10.6
41	50	21.5	1,090	22.7	—	21.9	—
42I	51	19.9	1,250	19.2		20.8	
	56	21.2	950	21.4	2.2	23.2	2.4
176I	52	20.1	791	21.3		23.6	
	60	22.8	454	26.1	4.8	29.2	5.6
176III	52	19.1	1,035	18.8		21.7	
	64	23.2	539	26.0	7.2	28.5	6.8
176IV	52	20.2	827	22.1		23.4	
	64	23.9	362	29.1	7.0	31.8	8.4
262	46	17.4	1,462	17.7		18.8	
	53	20.2	867	22.1	3.4	23.2	4.4
263I	35	12.3	3,245	11.7		12.9	
	42	15.4	1,731	15.9	4.2	17.0	4.1
263II	35	13.1	3,777	11.7		12.6	
	42	16.0	3,271	14.1	2.4	14.5	1.9
263III	35	13.4	1,695	14.0		15.7	
	42	16.8	988	18.5	4.5	20.1	4.4

(Continued from back cover)

Quednau, F. W. 1971. New and little-known aphids (Homoptera: Aphididae) from eastern North America. Can. Entomol. **103**:1083-1106.

Retnakaran, Arthur. 1971. A method for determining sperm precedence in insects. J. Econ. Entomol. **64**:578-580.

Ripley, R. A. and D. P. C. Fung. 1971. Flash pyrolysis of aspen and black spruce lignins—The effect of inorganic salts. Wood Sci. **4**(1):25:31.

Shen, K. C. 1971. The relationships between torsion shear and other strength properties of particleboard. Forest Prod. J. **41**:40-43.

Smirnoff, W. A. 1971. Susceptibility of *Dahlbominus fuscipennis* (Chalcidoidea: Eulophidae) to the microsporidian *Thelohania pristiphorae*. Can. Entomol. **103**:1165-1167.

Strang, R. M. 1970. The ecology of the rocky heathlands of western Nova Scotia. **In** Proc. Annual Tall Timbers. August).

Thomas, J. B. 1971. The immature stages of scolytidae: The genus *Conophthorus* (Coleoptera: Scolytidae). Can. Entomol. **103**:1021-1026.

Whitney, R. D. and W. P. Bohaychuk. 1971. Germination of *Polyporus tomentosus* basidiospores on extracts from diseased and healthy trees. Can. J. Bot. **49**:699-703.

Wilson, G. C. and J. M. Burke. 1971. *Nosema thomsoni* n. sp., a microsporidian from *Choristoneura conflictana* (Lepidoptera: Tortricidae). Can. J. Zool. **49**:786-788.

Yoshimoto, Carl M. 1971. A new species of the genus *Zamischus* and description of the male *Z. braziliensis* (Hymenoptera, Cynipidae: Eucoilinae). Can. Entomol. **103**:979-982.

Yoshimoto, Carl M. 1971. A new genus of mymarid wasp (Hymenoptera, Chalcidoidea Mymaridae) from New Brunswick, Canada. Can. Entomol. **103**:1071-1082.

Recent Publications

Althen, F. W. von. 1971. Mouse damage in an 8-year-old plantation. Tech. Note. Forest. Chron. 47 (June).

Bramhall, G. and J. W. Wilson. 1971. Axial gas permeability of Douglas-fir microsections dried by various techniques. Wood Sci. **3(4)**:223-230.

Brix, H. and H. Barker. 1971. Trials in rooting of Douglas-fir cuttings by a paired-cutting technique. Can. J. Forest Res. **1**:121-125.

Cayford, J. H. 1970. The role of fire in the ecology and silviculture of jack pine. **In** Proc. Annual Tall Timbers. (August).

Chow, S.-Z. 1971. Infrared spectral characteristics and surface inactivation of wood at high temperatures. Wood Sci. Technol. **5**:27-39.

Desai, R. L. and J. K. Shields. 1971. Effect of near ultraviolet light on fungi colonizing hardwood chips. Int. Biodetn. Bull. **7(1)**:11-13.

Dobbs, R. C. and D. R. M. Scott. 1971. Distribution of diurnal fluctuations in stem circumference of Douglas-fir. Can. J. Forest Res. **1**:80-83.

Durzan, D. J., A. J. Mia, and P. K. Ramajah. 1971. The metabolism and subcellular organization of the jack pine embryo (*Pinus banksiana*) during germination. Can. J. Bot. **49**:927-938.

Foschi, R. O. 1971. Stresses in curved glued-laminated timber beams: Experimental study. Forest Prod. J. **21**:42-48.

Funk, A. and R. A. Shoemaker. 1971. *Xenomeris abietis* associated with dieback of Douglas fir and western hemlock. Myocologia. **LXIII**:567-574.

Grinnell, Rae, 1971. Timber availability and supply from Canada's forests—The status as of 1968 and projections for the year 2000. Pulp Pap. Mag. Can. (February).

Gross, H. L. and M. J. Larzen. 1971. Nutrient content of artificially defoliated branches of *Betula papyrifera*. Phytopathology. **61(6)**:631-635.

Hatton, J. V. and J. L. Keays. 1970. Required: International standardization of pulp and paper evaluations. Pulp Pap. Int. (November & December).

Hayashi, Y and J. C. Cunningham. 1971. The release of viral genome RNA from virions of the cytoplasmic-polyhedrosis virus of *Malacosoma disstria* by acetone treatment. J. Invertebr. Pathol. **17**:433-439.

Heron, R. J. 1971. Temperature tolerance of pronymphs and pupae of the larch sawfly, *Pristiphora erichsonii* (Hymenoptera: Tenthredinidae). Can. Entomol. **103**:1153-1155.

Jeglum, J. K., C. F. Wehrbahn, and J. M. A. Swan. 1971. Comparisons of environmental ordinations with principal component vegetational ordinations for sets of data having different degrees of complexity. Can. J. Forest Res. **1**:99-112.

Johnston, J. S. and A. St-Laurent. 1971. How shears could replace saws for lumber trimming. Can. Forest Ind. (May).

Krywienczyk, Janina and Y. Hayashi. 1971. Specificy of serological cross-reactions between insect viruses and ribosomes. J. Invertebr. Pathol. **17**:321-326.

Lavallée, A. et A. Bard. 1971. Succession des micro-organismes à la suite de blessures artificielles au tronc chez le bouleau jaune (*Betula alleghaniensis* Britt.) et l'érable à sucre (*Acer saccharum* Marsh.), Can. J. Forest Res. **1**:113-120.

Manning, G. H. 1971. Canada's domestic demand for forest products: 1980 and 2000. Pulp Pap. Mag. Can. (February).

McIntosh, J. A. 1971. Logging equipment notes. British Columbia Lumberman. (April).

Meyer, R. W. and G. M. Barton. 1971. A relationship between collapse and extractive in western red cedar. Forest Prod. J. **21(4)**:58-60.

Outram, I. 1971. Aspects of mating in the spruce budworm, *Choristoneura fumiferana* (Lepidoptera: Tortricidae). Can. Entomol. **103**:1121-1128.

Park, J. Y. and B. Moore, 1971. A new ectomycorrhizal symbiont, *Hygrophorus chrysodon*, associated with American basswood. Mycologia. **LXIII(2)**:403-405.

Payandeh, B. 1970. Relative efficiency of two-dimensional systematic sampling. Forest Sci. **16**:271-276.

Porter, A. W. 1971. Some engineering considerations of high-strain band saws. Forest Prod. J. **21(4)**:24-32.

(Continued on page 37)

O.H.M.S.

DEPARTMENT OF
THE ENVIRONMENT
OTTAWA, CANADA