presence or absence of gonads. As the characteristics used for identification of female larvae was a negative one (i.e. the absence of male gonads), the identification was not always certain, therefore, if the sex characteristic was not clear the larvae were classed as unknown. Even so, some male larvae probably were classified as female. This would tend to reduce the measured mean below the true mean of the female larvae.

An interesting point to note is that the head-capsule width of the last instar of the two-year-cycle budworm is much larger than that of the one-year-cycle budworm. It has been suggested that this may be due to the difference in the length of the feeding period. The feeding period is from 21 to 40 days in Eastern Canada, (Swaine and Craighead 1924) and from 60 to 75 days in the Rocky Mountain Region.

HEAD-CAPSULE MEASUREMENTS

Instar	Sex	Number Measured	Mead Head Width	
			Rocky Mt. Budworm	Eastern * Budworm
I	Unknown	96	0·263	.....
IV	Female	177	0·627	0·660
	Male	121	0·625	0·635
V	Female	203	1·108	1·129
	Male	132	1·031	1·039
VI	Female	364	1·920	1·803
	Male	282	1·817	1·662

*Based on 1950 Annual Report by B. M. McGugan. — R. F. Shepherd.

Forest Insect Survey, Most Important Outbreaks.—A total of 2,303 samples were received in 1953. These samples, along with reports, disclosed that the important forest insects of the season were the lodgepole needle miner, the forest tent caterpillar, and the larch sawfly.

The infestation of the lodgepole needle miner, *Recurvaria* sp., in the national parks has changed but little since 1952, except for the re-establishment of a light population in the bottom of the Bow Valley. The forest tent caterpillar, *Malacosoma disstria* Hbn., occurred in spotty outbreaks over a great stretch of west central Alberta. From Medicine Lodge, west of Edson, the northern boundary ran east and north beyond Chip Lake and then to within a few miles of Edmonton, south to Gull Lake and Sundre, west to Bearberry and northeast to Rocky Mountain House. The heaviest defoliation was north of Chip Lake. The larch sawfly has extended its range in Alberta. Damage from this insect was noted as far west as Calling Lake, Smith, and Clyde. A few larvae were found at Weald, southwest of Edson, and at Caroline, south of Rocky Mountain House. The heaviest defoliation was at Cold Lake on the Saskatchewan border where in some cases the upper third of tree crowns were completely stripped.—W. C. McGuffin.

Decay of Subalpine Spruce on the Rocky Mountains Forest Reserves in Alberta.—During 1950 and 1952 an investigation of the decays and decay losses occurring in subalpine spruce, *Picea glauca* (Moench) Voss, *P. engelmannii* Parry, and *P. mariana* (Mill.) B.S.P., was conducted on the Rocky Mountains Forest Reserves by members of the Saskatoon and Calgary Forest Biology (Pathology) Laboratories. Four hundred and fifty-six living spruce trees on 12 sample plots (totalling 1·8 acres) distributed in the Brazeau, Clearwater, Bow River, and Crowsnest Forest Reserves were critically examined for the presence of decay.

An analysis of the individual trees showed that 35 per cent were infected, cull amounting to slightly under 20 per cent of the gross merchantable volume of the sample. Butt infections were present in 22 per cent of the trees examined and approximately the same percentage of trees in the sample had decay in the upper portion of the stem. Butt infections were responsible for 35 per cent of the cull deductions made for decay with the average length of the rot column at the butt extending 6·5 feet above a one-foot stump.

An examination of the age-decay relations of the individual trees reveals that spruce occurring in this region are relatively free from infection at 100 years, since at this age only 1 per cent of the trees were found to have decay. After 100 years there is an increasing number of infected trees in the stands until at 160 years half the trees can be expected to possess some decay. All the trees examined over 300 years old were infected.

The accompanying table summarizes the average gross merchantable volumes (Scribner's Log Rule), average cubic volumes, and percentage losses from decay of merchantable and understory trees in the immature, mature, and overmature age classes. It is evident that cull losses are proportionally higher in the slow-growing understory trees, i.e. trees under 11 inches d.b.h., than in the faster growing trees of merchantable size. Since the understory trees are also characterized by a younger mean age this relationship might be explained on the basis of a differential in rate of decay or in age of infection in the two groups of trees. Both merchantable and understory trees, however, appear to enter a critical period after 160 years when the increasing rate of decay accounts for cull losses of 18 to 23 per cent of the average gross merchantable volumes.

Age Class	Height Class [1]	Tree Class [2]	No. of Trees	Average Gross Volume (Bd. ft.) [3]	Percentage Cull	No. of Trees (Total Sample)	Average Gross [4] Cubic Volume	Percentage Decay	Average Age (Basis—Total Sample)
Immature (80–160)...	2	Understory	84	14·82	7·1	184	5·33	2·1	131
	3	Merchantable	27	117·51	3·1	27	27·01	1·2	140
Mature (161–200).....	2	Understory	11	17·58	21·5	24	5·99	8·5	178
	4	Merchantable	22	314·17	18·9	22	60·62	9·9	185
Overmature (201 plus)	2	Understory	50	23·86	25·2	73	7·62	10·4	243
	4	Merchantable	89	252·19	23·7	89	53·47	8·1	250

[1] Height of tree of average volume (1) up to 30 ft., (2) 31 ft. to 60 ft., (3) 61 ft. to 80 ft., (4) 81 ft. and over.

[2] Understory—trees 4″ to 11″ d.b.h.
Merchantable—trees over 12″ d.b.h.

[3] Board foot volumes computed according to Scribner's Log Rule.

[4] Volume between stump height (1 foot) and a 4-inch top diameter inside bark.

Thirteen of the 14 species of fungi most frequently isolated from decayed wood in this investigation are referred to wood-destroying Basidiomycetes. Three fungi of this group still remain unidentified. Until the positive identity of the unknown fungi has been established two of these have been assigned to Dr. M. K. Nobles' temporary designation "Unknown C" and "Unknown M". The one non-basidiomycetous fungus which has been most frequently isolated from decayed wood is thought by Miss Doreen Wells to be the imperfect form of *Coryne sarcoides* (Jacq.) Tul. It is not known, however, whether this fungus is capable of destroying wood.

In order of their importance as wood-destroyers in this region the fungi most frequently isolated from root- and butt-rots are *Polyporus circinatus* var. *dualis* Peck, *Flammula connissans* Fr., "Unknown C", and *Coniophora puteana* (Schum. ex Fries) Karst. *Fomes pini* (Thore) Lloyd, which was responsible for 25 per cent of the total cull, *Stereum sanguinolentum* Alb. & Schw. ex Fries, and "Unknown M" are the most important causes of trunk rots.—D. E. Etheridge.

BRITISH COLUMBIA

Some Aspects of Conifer Seed Microflora.—Moulds are recognized agents of deterioration of seed under sub-optimum storage conditions and of reduced germination of planted seed, especially where germination would be delayed; at least one common storage and soil mould has a definite pathogenic relationship with corn seedlings.

Collection, extraction, and storage of conifer seed sometimes takes place under conditions that encourage the growth or survival of moulds in large numbers, measured as viable spores. Assays of 23 seed samples, mostly from British Columbia, showed that many commercial lots of conifer seed have a large number of viable moulds, up to 10,000,000 per gm. The assays failed to show close correlation between high mould content and low viability of seed. This is attributed, in part, to the fact that the seed samples were of various ages.

It has been observed that, on some species of conifers, the immediate injury to seed resulting from moulding does

not appear to be great. This is probably because of the protection given by the relatively heavy seed coats. The microscopic examination of apparently undamaged seed showed that mycelium was present in the outer layer of cells of the hard seed coats. Mycelium was not observed in the inner papery seed coats in the samples examined. Cultural tests were carried out of dissected seed surface sterilized with 0·1 per cent mercuric chloride for 5 minutes. Fungi were isolated from kernels with and without corresponding isolation from seed coats.

This evidence suggests that moulds may penetrate Douglas-fir seed and may occur both externally and internally. These findings appear to substantiate the following statement of Davis, Wright, and Hartley: "Organisms that may cause decay after the seed is sown are sometimes found inside the seed coats of apparently sound, stored seed."

In the mould assays made, the fungi most commonly found were *Penicillium* spp., *Mucor* spp., *Aspergillus glaucus* Lk., and *Pullularia* sp. Within these four groups, five out of six isolates of *Aspergillus glaucus* did not grow at 5° C., but almost all the 18 isolates tested from the other three groups did. Thus, some of the more common seed moulds can grow at temperatures comparable to those under which conifer seed is usually stored in British Columbia. Growth of moulds would not be expected, however, in conifer seed stored at a moisture content of 8 per cent or less.—P. J. Salisbury.

Deterioration of Looper-killed Western Hemlock on Lower Vancouver Island.—During 1945 and 1946 extensive stands of mature western hemlock on lower Vancouver Island were attacked by the western hemlock looper. As a result, these defoliated stands suffered heavy mortality and thus became subject to pathological deterioration. Since information was lacking in regard to the deterioration of such timber, a series of periodic examinations were undertaken by the Forest Pathology Laboratory at Victoria, B.C., to determine the rate of decay of these stands and the identity of the causal fungi. Three such examinations have been made, the first in 1948, the second in 1950, and the third and final in 1953. This report presents a brief summary of results obtained to date from the final analysis.

Fifty-five hemlock, ranging in diameter from 12 to 50 inches, were analysed on a representative 1-acre rectangular plot in a 100 per cent looper-killed stand in the Wilson Creek area. Although all the trees were standing, none had retained their tops and only a few had retained any of their branches. In many cases a sizable portion of the upper bole was also missing. These losses, estimated to average between 5 and 10 per cent of the original gross volume, were attributed to the combined action of weathering, principally wind and snow, and weakening by fungi and insects.

The total volume of decay, excluding that occurring in the trees prior to their death, measured 74,278 board feet or 66 per cent of the total gross volume. Eighty-five per cent of the decay volume was recorded as advanced decay and 15 per cent as incipient decay. In the lower diameter classes, 20 inches and under, almost the entire merchantable volume was lost through the action of decay. In the larger diameter classes, the decay losses remained high but decreased from 90 per cent in the 25-inch class to 59 per cent in the 50-inch class.

The average depth of radial penetration has not been determined to date. While taking field data, however, it was noted that the depth varied considerably in trees of the same diameter as well as in trees of different diameters, but in all cases increased toward the tops which were mostly 100 per cent decayed.

Brown crumbly rot, caused by *Fomes pinicola* (Sw.) Cooke, the principal decay found associated with the deterioration of the looper-killed hemlock, accounted for 87 per cent of the recorded decay volume. Yellow stringy and white spongy rots were responsible for most of the remaining decay volume which was confined primarily to the lower sections of the butt logs. The principal fungi associated with these latter rots have been tentatively identified as *Armillaria mellea* (Vahl ex Fr.) Quél. and *Fomes annosus* (Fries) Cooke. Pitted saprot, caused by *Polyporus abietinus* Dicks. ex Fries, was noted in the sapwood of some of the trees but not in measurable quantities, although in the earlier examinations this fungus was one of the more important saprots. Several other fungi, still unidentified, were also isolated from the affected trees, but the volume of decay associated with them was generally insignificant.—N. T. Engelhardt.

RECENT PUBLICATIONS

Davis, J. M. and K. R. Elliott. A rapid method of estimating aerial spray deposits. J. Econ. Ent. 46: 696-698. 1953.

Denyer, W. B. G. and C. G Riley Decay in white spruce at the Kananaskis Forest Experiment Station. For. Chron. 29: 233-247. 1953.

Evans, David. Field key to Geometrid larvae of the British Columbia coast. (Multigraphed publication).

Foster, R. E. and A. T. Foster. Estimating decay in western hemlock. III. Suggested aids to the management of mature hemlock-spruce forests on the Queen Charlotte Islands. British Columbia Lumberman 37, No. 10. 1953.

Greenidge, K. N. H. Further studies of birch dieback in Nova Scotia. Can. J. Bot. 31: 548-559. 1953.

McGinn, W. K. and A. G. Davidson. Studies on white pine blister rust in Nova Scotia. For. Chron. 29: 267-272. 1953.

Reeks, W. A. The establishment of introduced parasites of the European spruce sawfly (*Diprion hercyniae* (Htg.)) in the Maritime Provinces. Can. J. Agr. Sci. 33: 405-429. 1953.

Smith, C. C. Control of the winter moth on shade trees. Can. Dept. Agr. For. Biol. Div. Processed Publ. No. 3. 1953.

Smith, S. G. A pseudo-multiple sex-chromosome mechanism in an Indian gryllid. Chromosoma. Bd. 5: 555-573. 1953.

Thomas, G. P. and D. G. Podmore. Studies in forest pathology. XI. Decay in black cottonwood in the middle Fraser region, British Columbia. Can. J. Bot., 31: 675-692. 1953.

EDMOND CLOUTIER, C.M.G., O.A., D.S.P., Queen's Printer and Controller of Stationery, Ottawa, 1954.

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