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

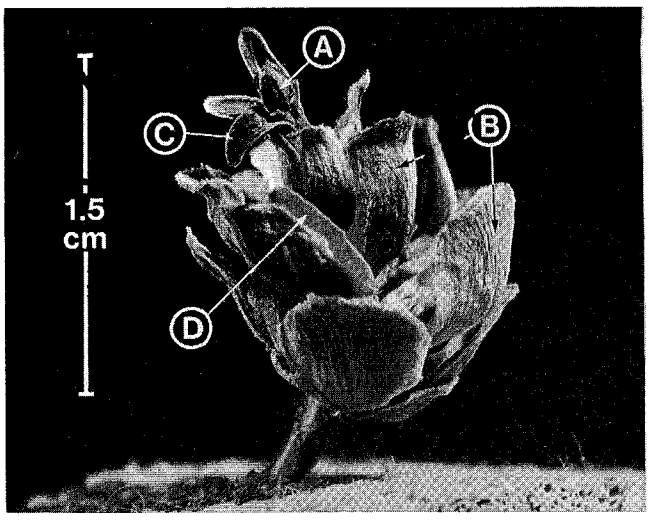

FIGURE 1. Proliferated cone of western hemlock. A—terminal bud; B—cone scales; C—needle; D—seed wing.

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)