

THE CONTROL OF BARK-BEETLE OUTBREAKS IN BRITISH COLUMBIA.

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The forests of British Columbia have been subject to great losses from year to year, through two chief agencies, fires and destructive insects. Fire is the more spectacular, but the depredations of insects are at the present time of much greater importance in the open stands of yellow or bull pine with which this circular chiefly deals.

There is considerable loss due to the attacks of various bark-beetles in nearly all our British Columbia coniferous trees. For instance, bark-beetles kill each year many western white pines, (*Pinus monticola*), and in some districts in the Province have become epidemic and have killed the greater part of the white pine timber. Douglas fir (*Pseudotsuga taxifolia*), is subject to attack by the Douglas Fir Bark-beetle and at least two such epidemic areas are now known to exist. Stands of true fir or Balsam, (*Abies*), are dying here and there from bark-beetle attacks. By far the greatest losses occur in lodgepole (*Pinus contorta*) and yellow pine (*Pinus ponderosa*) and are mostly confined to the southern part of the interior.



Fig. 1 Beetle-killed Yellow Pine, Southern British Columbia. (Original).

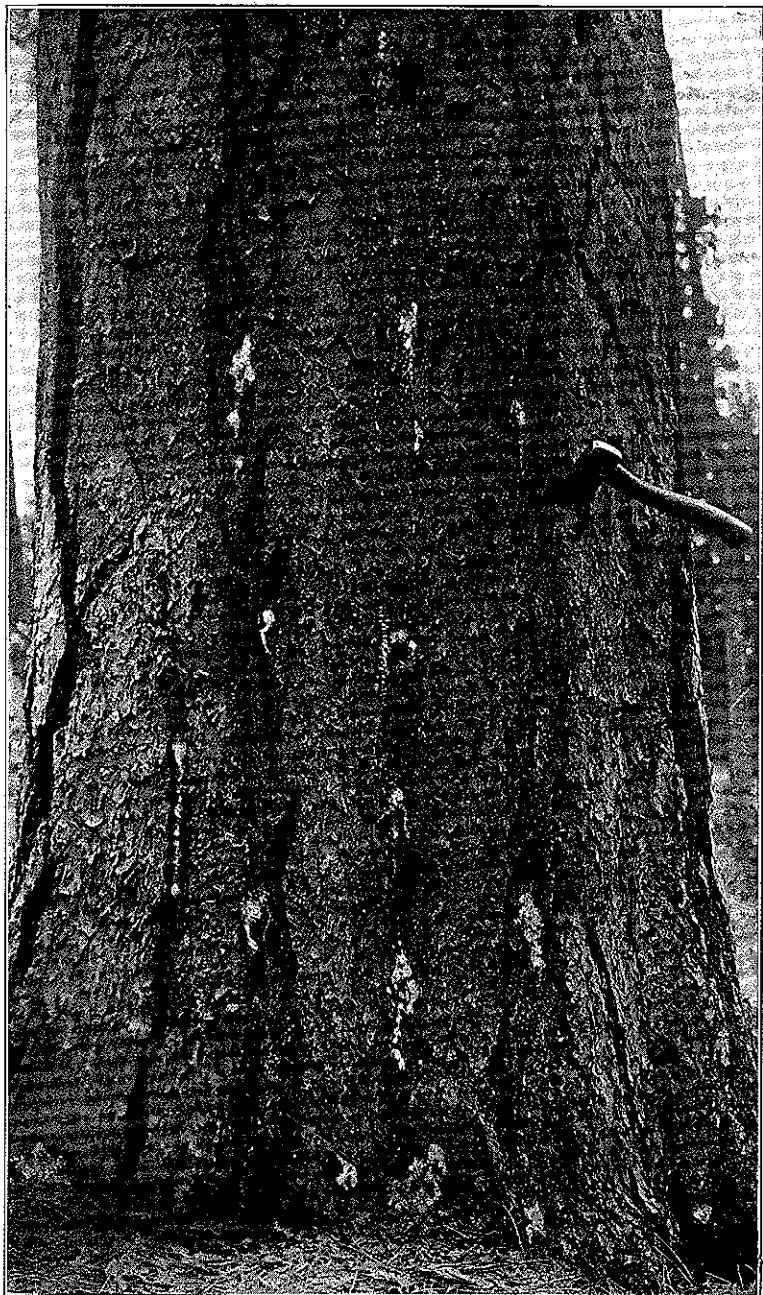


Fig. 2. Dying Bull Pine showing gum-tubes of *Dendroctonus* on the bark, Princeton, B.C. (After Swaine.)

The largest outbreak in lodgepole pine is in the Yahk district in the south-eastern part of the Province, but various epidemic areas of greater or less magnitude occur between Penticton and Nelson and between Penticton and Princeton.

The losses in yellow pine have been much the most serious, owing not only to the greater commercial importance of this pine, but also to the virulence and long sustained attack of the bark-beetles causing the injury. The greatest outbreaks, in which the loss has been excessive, have occurred around Princeton, where it is estimated that 150 million board feet have been killed during the past six years, and in the Coldwater Valley, near Merritt, where a very active infestation is now in progress. It is evident that the yellow pine in this whole forest between Princeton and Kamloops is threatened with ruin by these outbreaks, and that our control operations, now being conducted through the co-operation of the British Columbia Forest Branch, the Dominion Forestry Branch and the Dominion Entomological Branch, offer the only hope of saving it. Fortunately they promise to be successful.

TYPES OF BARK-BEETLE INJURY.

1. An endemic or so called "normal" infestation exists in almost all forests, in which over-mature or weakened trees or their parts are killed here and there from bark-beetle attacks.

2. Sporadic outbreaks frequently develop in the neighbourhood of slash, windfalls or light burns, particularly in bodies of weakened timber, but subside before many trees are killed.

3. Epidemic outbreaks result from a more serious disturbance of nature's equilibrium, from either natural or artificial causes, and spread rapidly through the forest killing great numbers of trees in a very short period.

An endemic infestation need cause little concern, although it effects considerable loss when this is computed over a period of years, and it is, of course, from this normal infestation that the serious outbreaks develop. The sporadic outbreaks, although small, may be important in stands of valuable timber, and may develop, if not controlled, into the more serious epidemic type. The epidemic outbreak is a serious matter, often killing 95% of the timber stand, in certain tree species, in the short period of five or six years. Control measures for epidemic outbreaks should be undertaken with the least possible delay, under the direction of a competent forest entomologist.

CAUSES OF BARK-BEETLE OUTBREAKS.

It appears probable that serious bark-beetle outbreaks usually develop through some notable disturbance of the natural conditions in the forest, such as windfalls over large areas where many trees are blown down, fires caused by lightning, or through human agency, such as carelessness with fire, lumbering operations, or slashings of any description.

In windfalls and fires, we have conditions produced in which the bark-beetles are not hampered by the resistance of the healthy trees. The bark-beetles breed freely under these conditions and often start outbreaks as a result immediately following the fire or heavy windstorm.

In logging operations we have a much more prevalent cause of epidemics. The immense amount of fresh slash, in the form of tops and cull logs, affords an ideal breeding ground for the destructive bark-beetles. The method of logging in the winter and not in the summer has been especially favourable to attack upon the standing timber. The beetles completing their life-cycle in the freshly cut material emerge and, having no new supply of cut material to enter, for they will not breed in dry logs, enter the living standing trees and kill them within one year. They then spread from year to year throughout the timber

stand leaving devastation in their wake. They also produce conditions favourable to the increase of other insects, usually considered as secondary, which, if they do not kill trees outright, nevertheless injure or kill parts of trees and assist the more important species in the general destruction.



Fig. 3 Slash. A breeding ground for Bark-beetles. (Original).

THE DESTRUCTIVE BARK-BEETLES.

The most important pine killing bark-beetles of British Columbia belong to two species of the genus *Dendroctonus*, of which one confines its attack to yellow pine, while the other attacks not only yellow pine but white pine and lodgepole pine as well.

In general, the method of attack is the same for both species. Emerging from a recently killed host tree in June or July they attack other trees during July and August. Entrance tunnels are cut through the bark to the wood surface and from the ends of these they excavate tunnels in the inner bark or between the bark and the wood surface, in which they lay their eggs in small niches cut along the sides. The larvæ which hatch from the eggs also cut galleries more or less at right angles to the egg-tunnels and thus generally complete the killing of the tree by girdling it from top to base. Transformation to the pupal stage takes place either in the autumn or during April and May of the following spring, and the new brood of adult beetles emerges through exit-holes in the bark to attack fresh trees and thus extend the outbreak.

YELLOW PINE (*Pinus ponderosa*)

Lumbering operations in south central British Columbia are confined largely to this species. It is attacked by two important bark-beetles, the Mountain Pine Beetle and the Western Pine Beetle.

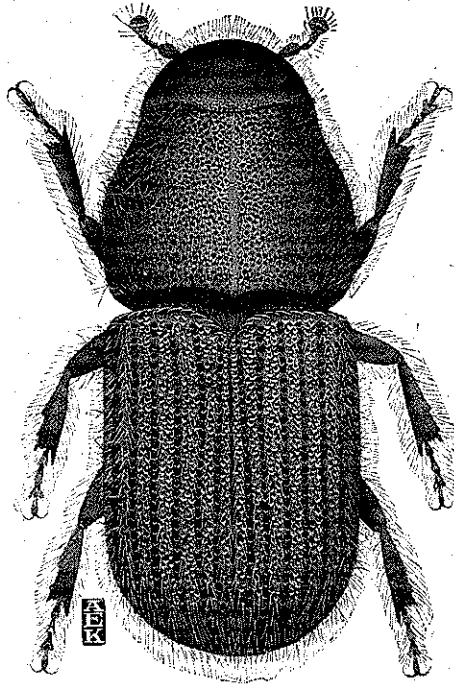


Fig. 4. The Western White Pine Bark-beetle. (*Dendroctonus monticolae* Hopk.). Greatly enlarged. (After Swaine)

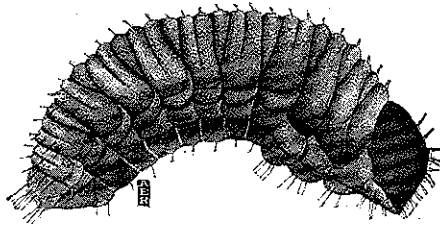


Fig. 5. Larva or grub of the Western White Pine Bark-beetle. Greatly enlarged. (After Swaine).

THE MOUNTAIN PINE BEETLE, or Western White Pine Beetle, *Dendroctonus monticolae* Hopk.

This species excavates both egg-tunnels and larval galleries in the bast or inner layers of the bark. The transformation from the larva or grub to the adult beetle also takes place between the bark and the sapwood. The egg-tunnels are longitudinal and characteristic of the species. Around the entrance hole on the bark is generally found an exudation of pitch known as a pitch-tube. The exit-holes are without these pitch tubes and are comparatively few in number, since many adult beetles emerge from the same exit-hole.

The Mountain Pine Beetle generally prefers comparatively young trees or the upper portions of mature trees where the bark is not too thick.

The adult beetles are black when mature and average about 5 mm., less than one-fourth of an inch, in length. The larvæ, or grubs, are about the same length as the adults, but are white in colour, legless, larger towards the head and curved like a bent finger.



Fig. 6. Inner face of bark from a beetle-killed Bull Pine, showing egg-tunnels and larval mines of the Western White Pine Bark-beetle.—1. Egg-tunnel of The Western White Pine Bark-beetle.—2. Larval mines of the same.—3. 3a., Egg-tunnel of *Ips integer* Eichh. (Alter Swaine).

THE WESTERN PINE BEETLE, *Dendroctonus brevicomis* Lec.

This species excavates winding egg-tunnels, crossing and recrossing each other and forming a network of tunnels between the bark and sapwood, in the inner bark or bast layers. Unlike the Mountain Pine Beetle the larval galleries

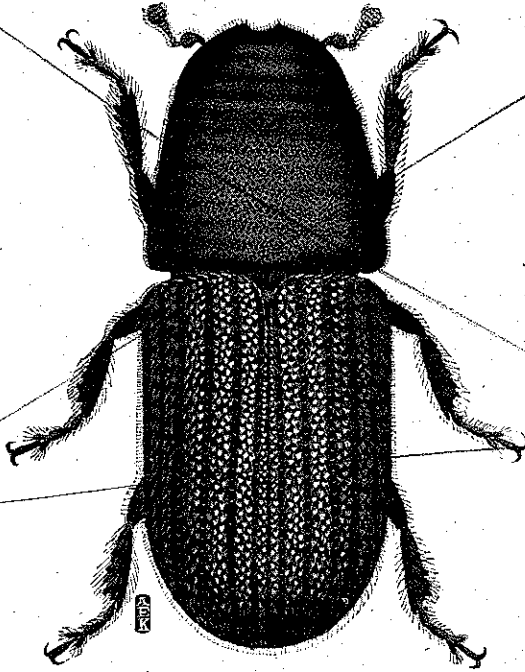


Fig. 7. The Western Pine Bark-beetle. (*Dendroctonus brevicomis* Lec.). Greatly enlarged. (After Swaine).

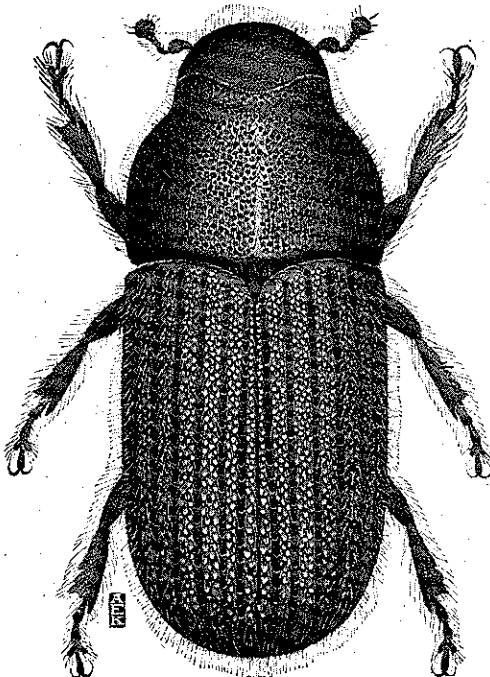


Fig. 8. The Douglas Fir Bark-beetle. (*Dendroctonus pseudotsugae* Hopk.). Greatly enlarged. (After Swaine).

of this species penetrate outward into the middle layers of bark and, after transforming to the adults, the young beetles emerge through the outer layer of bark, making small exit-holes generally referred to as "shot-holes." Since each beetle emerges through its own exit-hole the surface of the bark is covered with these "shot-holes" after the emergence of a brood. The adult beetle, also black in colour, is much smaller than the preceding species, averaging 4 mm. or threesixteenths of an inch in length. The two species are easily distinguished by the shape, as illustrated in the figures, and by the form of the egg-tunnels. The larvæ have the same general appearance.

DOUGLAS FIR (*Pseudotsuga taxifolia*).

Bark-beetle injury to Douglas fir is caused by another species, namely the Douglas Fir Beetle, *Dendroctonus pseudotsugae* Hopk. The adult beetles excavate egg-tunnels which are longitudinal but differ from those of other species in having the larval galleries arranged fan-wise, in groups, alternately from opposite margins of the tunnels. Typical pitch-tubes are not formed at the entrance-holes, although the pitch is evident there in the form of granulate particles, which often do not adhere to the entrance but fall and are caught in the bark crevices, together with considerable reddish boring-dust.

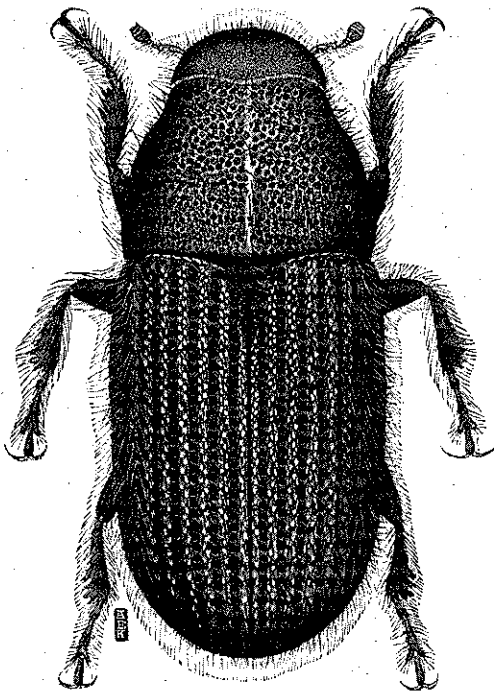


Fig. 9. The Sitka Spruce Bark-beetle. (*Dendroctonus obesus* Mannh.). Greatly enlarged. (After Swaine).

THE SPRUCES (*Picea sitchensis* and *Picea engelmanni*).

These trees, known as Sitka spruce and Engelmann's spruce, are each attacked and killed by a species of *Dendroctonus* known in the former case as the Sitka Spruce Beetle, (*Dendroctonus obesus* Mannh.) and in the latter as the Northern Spruce Beetle, (*Dendroctonus borealis* Hopk.). In these species both the egg-tunnels and the larval-galleries are excavated between the bark and the sapwood. Many small groups of trees are killed throughout the Province by these bark-beetles, but no extensive outbreaks have thus far been reported.

LODGEPOLE PINE, (*Pinus contorta*).

This pine is killed by the Mountain Pine Beetle, *Dendroctonus monticolae*, already mentioned as killing yellow pine. Its method of work is practically the same in both trees. Pitch tubes on the bark are, however, in greater evidence on lodgepole pine, the white pitch masses being very conspicuous on all infested trees.



Fig. 10. Egg-tunnels and larval mines of the Douglas Fir Bark-beetle on the inner face of Douglas fir bark. The boring dust has been removed. (After Swaine).

WESTERN WHITE PINE (*Pinus monticola*).

This pine is also killed by the Mountain Pine Beetle, indeed it was from this tree that the beetle received its name. Beetle-killed trees are common, apparently, wherever the white pine is found in British Columbia. Outbreaks in valuable stands should receive attention at the earliest opportunity.

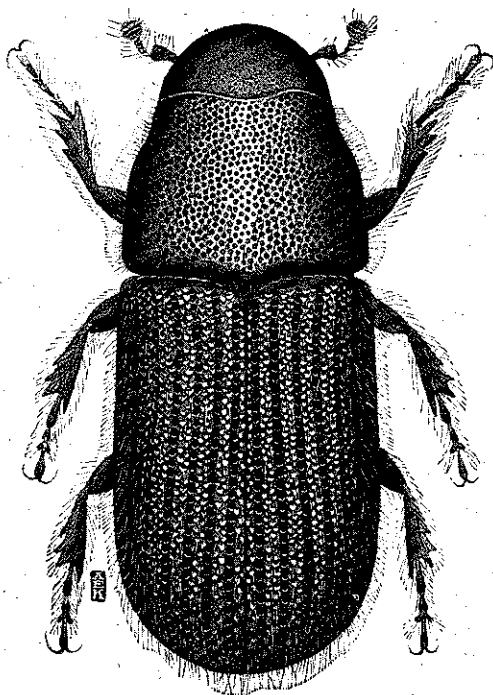


Fig. 11. The Red Turpentine Bark-beetle. (*Dendroctonus valens* Lec.). Greatly enlarged. (After Swaine).

A very common species of *Dendroctonus*, to be found in the bases of all pines, is known as the Red Turpentine Beetle, *Dendroctonus valens*. It causes serious injury to the base of the trunk and undoubtedly assists the other species, just described, in killing the trees. It is larger than the other species, averaging about 7 mm. or five-sixteenths of an inch in length, and is seldom found as high as 20 feet from the base. Although the egg-galleries are longitudinal the larvæ do not cut individual galleries, but work side by side in infantry formation, devouring all the inner layers of the bark and thus creating a large larval chamber.

All these destructive species, the true bark-beetles which cause the death of pines and spruces, have a common habit of packing the egg-tunnels with sawdust and depositing their eggs in small niches cut along the tunnel sides. This habit of packing the egg-tunnels with sawdust will generally distinguish the work of these destructive beetles from that of numerous secondary bark-beetles which follow up the primary attacks.

THE CONTROL OF BARK-BEETLE OUTBREAKS.

Any increase in dying trees should be reported as soon as possible to the Forest Entomologist, Entomological Laboratory, Vernon, B.C., in order to enable him to examine the area and co-operate in the suppression of any outbreak.

On account of the enormous multiplication of these bark-beetles in freshly cut slash, windfalls and extensive snow breaks, care should be taken to burn all such debris before May 1 of each year.

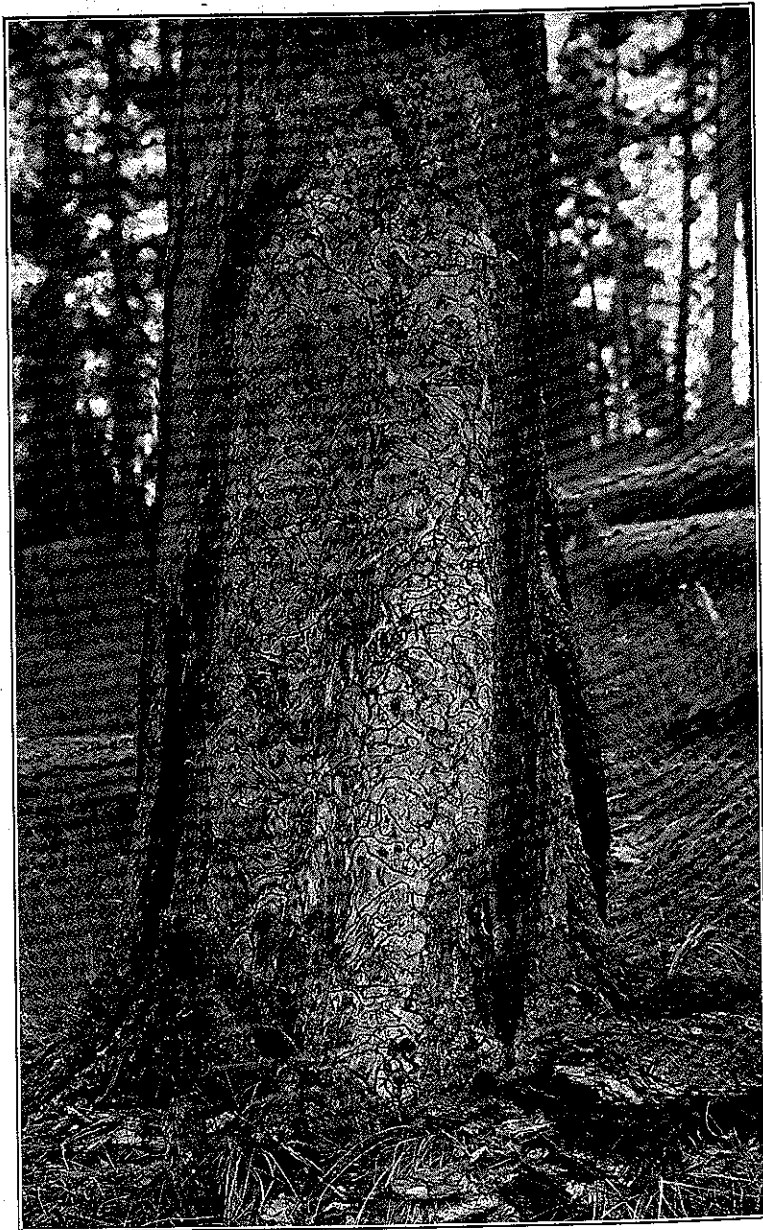


Fig. 12. Dying Bull Pine, showing egg-tunnels of the Western Pine Bark-beetle on the wood surface. Princeton, B.C.
(After Swaine).

In order that the slash burning may be effective, brush and limbs must be piled over each top in sufficient quantity to enable the fire to burn off the bark entirely and not merely to scorch it.

Cull logs should be dealt with in the same way or else they should be peeled and the bark raked up and burned. The size of the cull log will determine the most economical method.

Where lumber companies are operating in an infested area, a special effort should be made by the company to cut the infested portions immediately and move the logs to the mill as soon as possible. There the logs should either be placed in a pond, thus drowning the infesting broods of beetles, or the slabs should be burned immediately after sawing. Logs in the woods or on rollways should never be left over one year in the woods. If these rules for disposing of the infested cull logs, tops and pine brush are followed much infestation of standing timber may be avoided.

Where the infested timber cannot be cut economically on account of inaccessibility, direct control measures must be instituted. A control crew should operate in the infested area during April and May, under the supervision of an experienced forest entomologist. The infested trees must be marked, in order to avoid useless labour in felling abandoned trees or trees upon which the beetle attack failed (usually called "drowned out trees"). The marked trees must be cut and the bark and limbs burned. Trees of large diameter should be peeled well up into the limbs, the top bucked back, the slash piled over the unpeeled portion, the bark raked into windrows along the sides of the trunk, and the whole burned, thus leaving only the slightly scorched trunk upon the ground. This trunk may then be used if it is sufficiently valuable. Trees of small diameter should be bucked into piles and the whole pile burned. Care should always be taken, however, to burn the pile thoroughly so as to destroy all the bark and limbs.

It has been found economical to employ a crew of 18 men. Of these, 15 are divided into 5 crews of 3 men each, one man of each 3-man crew being appointed foreman. Two men of each 3-man crew should be experienced timber fallers and should fall and limb the trees, piling them or barking them as required; and the third man, the burner, should clean up and burn the piles, besides constructing fire lines around the trees to prevent the fire from spreading.

The remaining three men of the 18-man crew should consist of a cook and helper, with the usual duties, and a camp boss, who should not only manage the camp and work in the woods, but should also mark the trees for cutting, after being properly instructed by the entomologist.

Three double-bitted falling axes, two 4 or 6 lbs. falling wedges, a 7 foot saw, a bottle of coal oil, two shovels, and one rake should be supplied each crew of three men.

If a thorough campaign of slash disposal and control of incipient outbreaks is carried on in the future, the tremendous loss caused in the past to the forests of the Province will not only be stopped, but much of the fire risk now caused by slash and dead standing timber will cease to exist.



Fig. 13. Inner face of bark from a dying Bull Pine at Princeton, B.C., showing tunnels of the beetles which have killed the tree.—1, Egg-tunnels of The Red Turpentine Bark-beetle.—2, Larval-chambers of the same, excavated by the young larvæ working in congress.—3, Egg-tunnels of the Western Pine Bark-beetle, showing egg-niches and, a few larval-tunnels. The boring-dust has been largely removed. (After Swaine).