The Scolytoidea of the Northwest
Oregon, Washington, Idaho
and
British Columbia

BY
W. J. CHAMBERLIN

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By

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Professor Emeritus

of

Forest Entomology

Oregon State College

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Acknowledgment

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S. L. Wood checked the Canadian National Collection for records from the Northwest, particularly British Columbia. He also straightened out certain misidentifications regarding British Columbia records and gave advance information on synonymy which he had uncovered in certain genera and which has not at this time been published. Dr. Wood was also very helpful in making identifications or confirming our own. In addition, he furnished a number of names to be added to the Idaho list from his personal collecting in the extreme southern part of the state. G. Stace Smith of Creston, British Columbia, checked the list against his own very extensive collection and thereby added a few species not reported elsewhere in the Province. He also kindly loaned some specimens for study. Melville Hatch of the University of Washington loaned the entire collection of Scolytidae from that institution for the study. H. C. Richmond of Victoria, British Columbia had the list checked at that laboratory and W. G. Mathers performed the same service at Vernon, British Columbia. H. M. Leech of the California Academy of Sciences gave all possible help to the writer in checking the collection at the California Academy of Sciences. This includes a large portion of the collection of the late Ralph Hopping.

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Dr. A. D. Hopkins (1857-1948) and M. W. Blackman (1876-1943) were also outstanding workers on the taxonomy of Bark Beetles.
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The Scolytoidea of the Northwest

Bark and timber beetles have long been among the principal enemies of our forests. Recent widespread epidemics of the Engelmann spruce beetle and the Douglas-fir beetle caused the destruction of billions of board feet of merchantable timber in the West. This severe loss served to focus the attention of entomologists, foresters, and the general public on this group of insects.

Sudden outbreaks of species such as the two mentioned above, or others, emphasize the impossibility of forecasting population peaks. When conditions are favorable species considered of little or no economic importance may become epidemic and inflict heavy losses. Therefore, an account of all species known to inhabit a region should be of value.

In discussing the Scolytoidea as a whole, some references are made to species not found in this area since much of the information obtained by careful, intensive study of habits in other locations may also be applicable in this region. Emphasis has been placed upon endemic species, and in the keys, morphological characters are supplemented in some cases with known biological data. This includes items such as hosts and types of galleries when closely related species are considered. For example, *Dendroctonus obesus* (Mann.) is found only in Sitka spruce, and *D. pseudotsugae* Hopk. is the only species of the genus found in Douglas-fir in this area. The part of the tree attacked and the type of tunnel will be found of considerable value in separating certain species, such as some closely related species of the genus *Phloeosinus*. Other examples will be encountered as the keys are used.

Tunnels of the various species are described in detail so far as information is available, and many are figured. Complete descriptions of the galleries of many species are not available.

There are numerous examples of misidentifications in the older literature, and some of these errors are still carried into the more recent articles. *Leperesinus aculeatus* Say is still given as the species found in the Northwest, whereas species in this area actually are *L. oregonus* Blkm. and *L. californicus* Sw. *L. aculeatus* does not occur west of the eastern slopes of the Rocky Mountains. Hosts cited in older articles are often of only questionable value, for splitting of older complexes has shown that what was considered one species with numerous hosts is in reality several species, each with a distinct host.

Intensive collecting has extended the host lists. The several revisional studies by Blackman, based on extensive collections of the National Museum, have been of great value in separating new species and associating correct hosts. The collecting was primarily done by the U. S. Department of Agriculture workers who were trained observers, able to accurately name the trees from which the series or individual specimens were taken. Where it seems advisable, and if it is known, the collector's name is cited. This applies particularly to rare species, or those reported from either unusual localities or
unusual hosts. Recent papers by S. L. Wood have been of great taxonomic value in some of the groups.

This report includes the states of Oregon, Washington, and Idaho, and the Province of British Columbia.

As known at the present time, there are 37 genera and 162 species of Scolytoidea found in the Northwest and treated in the following pages.

General Remarks on the Superfamily SCOLYTOIDEA

This superfamily, as found in America north of Mexico, consists of two families, Platypodidae and Scolytidae. The former contains a single genus in our fauna, while the latter is made up of about 73 genera. Eighteen of these genera have only a single described species in North America.* The other extreme is represented by the genus *Pityophthorus* which now contains 110† described American species.

There are undoubtedly numerous forms as yet undescribed, though our list now contains over 625 species.

Members of this superfamily are well adapted for their concealed life in plant tissue, where almost the entire life cycle is accomplished. They attack all parts of trees and shrubs. Fruits, roots, twigs, limbs, bark, cambium, seeds, cones, and solid wood all provide places attractive to one or more species. Most species feed upon starchy sugars and other nutritive matter in the plant, but a number of genera subsist upon fungi which they plant and cultivate within their galleries. These latter species exhibit a certain amount of parental care in rearing their young.

Many species are monogamous and work in pairs. Many others practice polygamy which may vary from simple, in which 2 to 5 females may be associated with one male (*Ips, Pityophthorus*, etc.) to intense, as represented by *Xyleborus*. Hopkins reports finding as many as 60 females associated with a single male in some species of *Xyleborus*.

Although the common hosts are various woody trees and shrubs, there are numerous exceptions when the world fauna is considered. No less than seven species are reported from the coffee plant and several from the tea plant. Sugar cane and cotton bolls are reported as hosts. *Eurydactyles sexspinosus* Mots. is said to attack rice; one species of *Cactopinus* works in opuntia cactus. Date seeds, cornstalks, gourds, and several varieties of fruits furnish hosts for one to several species. None of these nontypical forms have been found in the Northwest.

Economically the superfamily is very important. The families constitute the most important enemies of our coniferous forests, and in addition many prey upon broad-leaf trees. Losses to forests and forest products amount to

* When reference is made to North America it is to be understood that Mexico is not included.
† This is based on Blackman’s revision but it is certain that some species recognized by that author will be placed in synonymy.
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millions of dollars annually. Several species are serious pests of orchard trees, while others destroy valuable street and shade trees. In recent years species attacking elms have received special attention. The rapid spread of the Dutch elm disease is largely due to the spreading of spores by the European elm bark beetle (*Scolytus multistriatus* [Marsh.]). This species has recently been reported from California and Idaho.

The clover root borer (*Hylastinus obscurus* [Marsh.]), another European species, was introduced years ago and has become distributed throughout the entire United States where it causes considerable loss of legume plants.

From the biological standpoint, few beetle families offer a more fascinating field for study than do species of this group. They excavate their own homes, and some plant fungus gardens, care for their young, and show evidence of a communal life. In their homes are found other insects of several orders, including parasites, predators, scavengers, and other associates.

Symbiotic relationships with creatures other than insects have also developed. Certain mites, nematodes, and pseudoscorpions are found as characteristic inhabitants of their galleries, and are transported from tree to tree by the beetles when they leave.

The beetles' association with fungi of various types such as blue-stain, parasitic, disease, saprophitic, and ambrosia or food fungi, furnishes a very interesting field for study.

Distribution of Scolytoidea

The Family Platypodidae is distinctly a tropical one, being well represented in the various southern regions. North of Mexico, there is but a single genus with 5 species, only 1 of which is found in the West. *Platypus wilsoni* Sw. ranges as far north as British Columbia on the west coast.

Scolytidae are world wide in distribution and many genera are cosmopolitan. Great variation in the extent of distribution of individual species is encountered, even within a genus. This may be exemplified by species of *Dendroctonus*. *D. valens* Lec. is probably the most widely distributed species we have, extending from Alaska to Labrador and south, in coniferous regions on both sides of the continent, into Mexico and Central America. It is found throughout coniferous regions of North America with the exception of the extreme southeastern portion of the United States, where it is replaced by the black turpentine beetle, *D. terebrans* (Oliv.). This wide range necessitates a great many hosts, including all pine species, larch, and occasionally other conifers. In the same genus are a number of species with rather restricted distribution. *D. arizonicus* Hopk. has been found only in the mountains around Williams and Flagstaff, Arizona. *D. jeffreyi* Hopk. occurs only in restricted California areas and very rarely in the extreme southern portion of Oregon. *D. obsesus*, *D. borealis* Hopk., *D. johanseni* Sw. and *D. rufipennis* (Kby.) all have rather limited distributions. With one exception, *D. micans* (Kugel.) the entire genus is restricted to North America and no species of *Dendroctonus* is found south of the equator.
Many species are limited in range by their host plant's distribution, which in turn depends to some extent upon climate and soil. When a monophagous species feeds upon a tree with restricted distribution, the insect will not naturally spread beyond the limits of its food plant. A species working only in Arizona cypress, Port-Orford-cedar, or weeping spruce, would of necessity have a very limited distribution. Such distribution, however, is subject to change. This may be exemplified by a species working only in Monterey pine or Monterey cypress. Both of these trees are extensively used as ornamentals and have been transplanted and grown in areas far from their native habitat. In many cases their insect enemies have followed.

Temperature seems to be the governing factor in certain other bark beetle distributions. When a series of mild winters are experienced along the Atlantic seaboard, the southern pine beetle, *D. frontalis* Zimm., extends northward rather rapidly, migrating as far as New York state. The first normal winter with its low temperature kills off the established broods and the insect again becomes the southern pine beetle.

Some species have become acclimated to severe winters as shown by *D. borealis* of interior Alaska and *D. johanseni* found at the very limits of tree growth in Canada, almost within the Arctic Circle. These species may require two or more years for a complete cycle but are able to withstand the rigors of severe winters, probably due, at least in part, to the fact that they mine prostrate trunks of dwarf trees which are entirely covered by snow in the winter.

**Scolytid Galleries**

Scolytid tunnels are of many types and are often so characteristic of the species that if familiar with the family one can readily identify the genus, and often the species, responsible for the work, though the insects have long since departed. Determination is facilitated when data as to host plant, part of the plant attacked and the exact locality of the collecting are available. Galleries of individual species sometimes vary due to interference by other species, knots or limbs, variation in size of the part of the plant attacked, thickness of the bark, the position of the tree (whether standing or down), and even the exposure to sun or shade.

Much data may be obtained from a careful study of scolytid tunnels, such as:

(a) The average pattern of the gallery.
(b) The maximum, minimum, and average length of the egg gallery and larval mines.
(c) The maximum, minimum, and average number of eggs deposited.
(d) Egg, larval, and pupal mortality.
(e) In fresh material the enemies and associates; such as predators, parasites, and inquilines; and not only insects, but disease, fungi, mites, etc., may be studied.
With few exceptions, members of this family are the only beetles tunneling into their hosts before depositing their eggs. Galleries fall into three general categories. 
(a) Ambrosia, or timber beetle galleries. 
(b) Bark beetle galleries. 
(c) Others.

Ambrosia or Timber Beetle Galleries

All the Platypodidae and members of the genera *Gnathotrichus, Xyleborus, Anisandrus, Trypodendron*, and *Monarthrum* of the family Scolytidae fall in this group. A few species of other genera make similar mines in the wood but differ in that their food is not ambrosia fungi and their galleries are not stained black.

Ambrosia beetles contain both monogamous and polygamous species, and four general types of galleries may be recognized.

(a) Cave Type: In this type of tunnel (fig. 1) the entrance mine runs directly through the bark into the sapwood where it widens into an irregular chamber on the walls of which the fungus is grown. There are no larval cradles and no mines leading from this cave. Eggs are deposited more or less indiscriminately and the larvae roam around at will. Example: *Xyleborus*.

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*Fig. 1. Cave gallery of ambrosia beetle*

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*There are other genera of ambrosia beetles in North America but they have no representatives in the Northwest.*
(b) Simple Tunnel: In this class the beetles go directly through the bark, entering the sapwood and often the heart wood. The mine is long, often winding (fig. 2), and may even make a complete loop. There are no branches or side galleries. Example: *Platypus*.

(c) Branched Type: This type is similar to "b" except that there are two to several branches, usually in pairs. These are generally on the same horizontal plane and commonly extend around the tree, running parallel with the annual rings (fig. 3). Example: species of *Xyleborus*.

(d) Compound Type: A tunnel, whether branched or not, containing individual cells or cradles (fig. 4) in which the larvae develop is termed compound. This is the common type of tunnel excavated by *Trypodendron*, *Gnathotrichus*, and others.

Regardless of the tunnel type, procedures are much the same for its construction. With some species, the male excavates the entrance tunnel and is joined later by one to several females. The beetles occupy their gallery as long as the moisture content of the wood is suitable for growing their food. They live a more or less social life, and at least in some species, care for the young not only by growing their food but by placing it so that the larvae may readily feed.
Bark Beetle Galleries

This group is represented by galleries completely or partially excavated in the cambium or the bark. There are, however, a few species which tunnel directly into the wood, but unlike the ambrosia beetles they do not feed on fungi. A majority of species have the primary gallery, larval mines, and pupal cells in the cambium. In some cases (*Dendroctonus brevicomis* Lec.), only the primary gallery is so situated with larval mines and pupal cells excavated entirely in the bark and not exposed by its removal. Certain species pupate entirely, or partially in the bark; while others pupate in cells partially, or wholly in the wood.

Many factors influence selection of the site where the gallery is to be excavated, such as: (a) species of tree; (b) physical condition of the host; (c) thickness of bark; (d) size of trunk or branch; and (e) orientation, whether the tree is standing or fallen.

Some species keep the egg gallery clean of frass and borings while others simply pack such material behind them as they progress. Trägårdh (30:469) suggests that the advantages to be derived from clean galleries are ventilation, more favorable temperatures, and moisture control. Certainly it facilitates repeated copulation in the polygamous forms. The task of keeping the galleries clean usually rests with the male; and in the case of very long galleries such as those of *Dendroctonus monticolae* Hopk., which excavate egg tunnels up to three feet in length, their task becomes burdensome. *Ips emarginatus* (Lec.) with its long egg galleries have many clean-out, or ventilation tunnels, reducing the work. In some of the polygamous species where a single male may be confronted with the task of disposing of material from 8 to 10, or even more, tunnels which females are excavating, it would appear to be so discouraging that it is not attempted.

With many genera of bark beetles, the elytral declivity is specialized in such a manner as to form a most convenient apparatus for pushing the borings and refuse out of the mine. It is significant that in many cases this specialization is more pronounced in the male than in the female, possibly because the former does most of the work along this line. Such genera as *Orthotomicus* and *Ips* show the greatest specialization in the shovel-like posterior, and in some of these species we find long galleries, occasionally extending down from the entrance tunnel. This means that in cleaning them, the beetles must overcome the force of gravity in getting the material up to the entrance and ejecting it from the tree. Rakelike tibiae and the flattened, or even concave front of the head are also of use in performing this cleaning work. The dense clothing of hairs is of assistance in cleaning the walls. After depositing eggs, the females carefully seal off the egg niches, pockets, or grooves until they are flush with the side walls in order that the runways may be uniform and offer minimum resistance to material being removed.

Entrance tunnels of nearly all bark beetle species slope up from the exterior to the cambium. This not only facilitates debris removal but prevents water from running into the gallery.
With a given species, it is noted that in standing trees the gallery will usually extend up from the entrance mine, while in a prostrate trunk the excavation may be toward either the top or the base. A rather remarkable fact is to be noted in the case of some *Ips* which excavate tunnels both up and down from the nuptial chamber. The gallery extending down is almost never directly below the one extending up, neither does it begin at the bottom part of the nuptial chamber. If either of the above were the case, much of the debris from the upper tunnel and the nuptial chamber would, by the force of gravity, fall into the lower tunnel from which it would have to be removed by the insects. The lowest point in the nuptial chamber usually leads directly into the entrance tunnel.

There are certain species not known to breed in fallen trees. This may be because it is difficult to take advantage of gravity in clearing the galleries of frass and borings.

There is often a distinct relationship between the direction of larval galleries and their depth in the wood. Species engraving the wood deeply, excavate their mines with the grain of the wood, while larval mines which lie wholly, or nearly so, in the bark may run in any direction.

Larvae start their tunnels from the egg niche, pocket, or groove, and work at more or less right angles to the egg gallery. This direction may be continued throughout their entire length, especially when the egg tunnel is transverse and the larval mines run with the grain of the wood. On the other hand, when the egg tunnel is vertical and the larval galleries start out across the grain of the wood, they almost invariably turn and run vertically. It is evident that the larvae are warned in some manner, perhaps by sound, when they approach another gallery, and the line of travel is changed enough to prevent actual coalescence or crossing. In cases where the cambium is crowded, larval mines may reverse and parallel the former course, heading toward the original starting point.

It is stated by Tragårdh that in transverse egg galleries, egg niches or pockets are very deep in the wood, while in longitudinal tunnels they are shallow, scarcely penetrating the wood and often lying entirely in the bark. He believes this influences the direction of the larval mines, and concludes that in species in which the food of the larvae consists primarily of wood, egg tunnels are deep and transverse. Niches are almost entirely in the wood and the larval tunnels are longitudinal.

Gallery type is no indication of relationship. The entrance tunnel is usually excavated by the male in the case of polygamous species and by the female in the case of monogamous species. A host is selected and the beetle carefully examines the surface until it finds a suitable spot to start excavation. Cracks or crevices, under bark scales, beneath lateral twigs or branches, or roughened spots on otherwise smooth bark may be chosen. Their position is usually maintained by digging the claws into the bark while the mandibles bite out bits of bark. Once the tunnel is well started, the position for excavation is facilitated by bracing against the side walls.
At the base of the entrance tunnel, that is, where it comes into the cambium, a turning niche (in monogamous species) or a nuptial chamber (in polygamous forms) is usually constructed. If neither of these is present, the female may be forced to come entirely out of the mine to reverse her position.

In monogamous species, the opposite sex may be waiting to join its mate even before the entrance tunnel is complete. In the polygamous forms, the male is usually joined by two or more females very soon after completing the nuptial chamber. In some cases, the chamber may be enlarged later to accommodate the increased materials if a large number of females select that particular mine. By contrast, cases of completed nuptial chambers have been noted where no females ever entered. In such cases the male may be found dead, or more often the chamber is found deserted.

Types of Bark Beetle Galleries

Many names have been applied to the various designs of burrows made by bark beetles, and probably 90% of these mines will fall into one of the following 8 classifications, but a few species have adopted some special type not readily falling into any of these more commonly recognized types.

1. The Cave Type (fig. 5)

This is thought to be the most primitive type and consists of an entrance tunnel which leads into an irregular opening in the cambium. The eggs are deposited singly or in small masses about the periphery of the cave, and they may or may not be partitioned off with borings. Examples of species excavating this type are Taenioglyptes amabilis (Chamb.) and Renocis heterodoxus Csy. The larvae usually tunnel out more or less en masse, simply enlarging the cave or they may excavate individual tunnels. In the case of Dendroctonus valens, the adult may excavate a wide tunnel, sometimes so wide and short as to be virtually a cave, and the eggs are deposited in masses along the sides. The larvae then work out gregariously, enlarging the cavity to such an extent that it may form a cave one foot across, or they may work gregariously for a time and then excavate individual tunnels.
2. Radiate or Star-shaped Tunnels (fig. 6)

This is an evolution from the cave type tunnel to accommodate the numerous females associated in the polygamous species. A central nuptial chamber is excavated in, or close to, the cambium, and from this cavity each female excavates her own egg tunnel radiating out. These may be straight or winding, long or short, and the number may vary from 3 to 8 or occasionally even more. The number of radiating tunnels is dependent upon the number of females associated with the male. This is the common type of tunnel excavated by many species of *Ips*, *Pityophthorus*, *Carphoborus*, *Dryocoetes*, *Orthotomicus* and others.

3. Forked Tunnels (fig. 7)

The typical forked tunnel consists of an entrance and two laterals; one of which extends one way and the other in the opposite direction. These laterals may be transverse or longitudinal, or may extend out more or less obliquely. The species may be monogamous or bigamous (with two females associated with a single male). Examples are *Scolytus ventralis* Lec., several *Phthorophloeo*us, *Alniphagus aspericornis* (Lec.), various *Pseudohylesinus*, *Leperisinus*, and others.
4. Simple Longitudinal (fig. 8) or Transverse Tunnels.
This type of tunnel is commonly short and nearly straight, with a spur or short lateral at the end enabling the insects to reverse directions. It is typical of several species of *Phloeosinus*, *Scolytus unispinosus* Lec., and *Hylastes*. In the case of larger species one finds much the same type of tunnel except that it may be 1 to 3 feet or more in length, and instead of being straight, is likely to be sinuous. Examples are several species of *Dendroctonus*, such as *D. monticolae*.

5. Irregular Elongate Tunnels (fig. 9)
This type of tunnel is typified by *Dendroctonus brevicomis* Lec. Egg galleries are long and very winding. They may cross and interwind with others of their kind, resulting in a maze of lines.

6. Pith Tunnels
A number of species of *Micracis*, *Pityophthorus*, and others do not work in the cambium or bark but enter twigs, and tunnel up or down the pithy center. The larvae feed upon the soft wood but do not cultivate ambrosia.

7. Wood Tunnels other than those of ambrosia beetles
Many species enter solid wood but differ from ambrosia beetles in feeding upon the wood rather than fungi. Their tunnels may be transverse or longitudinal; simple or branched; may extend up or down, or both ways from the entrance. Examples of such tunnels are found in certain species of *Micracis* and many other genera not represented in our territory.
8. Cone Tunnels (fig. 10)
In the case of the genus *Conophthorus*, tunnels usually enter the stem of the cone, and the egg gallery extends along the axis, with larvae working out into the seeds and scales. This type of gallery is essentially the same as a pith tunnel except that it is found in cones of various conifers.

Fig. 10. Gallery of *Conophthorus*

9. Other types
Species of *Coccotrypes*, which mine seeds, completely riddle the seed. *Xylocleptes* bore in plants belonging to the gourd family but the type of gallery has not been described. The same is true of a number of genera represented by only a few rare species, none of which are found in the Northwest.

Larval Tunnels

Larval mines begin as very minute passages, just large enough to accommodate the newly-hatched grub; they enlarge in diameter as they progress and as the larvae grow. Having reached maturity for the species, a pupal cell is formed in which the transformation from larva to pupa to adult occurs. Larval mines vary in length and often are much longer than the egg gallery with a one foot length not uncommon. Some species of *Ips* have very short larval mines and with species such as *Hylurgops*, working in older material, it is usually impossible to follow the individual mines as the cambium is likely to be destroyed. Larvae of a few species do not make individual mines but work out en masse. This is often the case with *Dendroctonus valens*. The larval mine may be entirely in the bark, entirely in the cambium, or entirely in the wood, or it may be in any combination of the above. A common situation is for the tunnel to start in the cambium and later enter the wood or the bark.

The pupal cell is usually oval elongate and may lie in the cambium, bark, or wood, depending upon the species. Only rarely is there any attempt to line the pupal cell.

With most species completing their development during the warmer part of the year, as soon as the adults harden they excavate an exit hole from the pupal cell directly to the outside. Some species however, feed for a few days or even weeks before leaving the tree in which they developed. Species maturing in the fall often pass the winter as young adults in the pupal cells, emerging when warm weather comes in the following spring.
Ventilation Tunnels

It is not unusual to find short mines extending from the primary tunnels to the outside. These are usually present with those species which excavate very long egg mines. These are called ventilation tunnels, although the reason for their excavation is not definitely known. Ventilation certainly is not their only use, since they also serve as convenient outlets for frass and tunnel borings. It would appear that they might be more detrimental than useful in some cases by furnishing a ready means of entrance for insect enemies of the beetles.

A number of species, such as Polygraphus rufipennis Kby., Dryocoetes confusus Sw., some Dendroctonus, and others, excavate 2 to 5 egg tunnels. These may be extensions of the previous tunnel or they may leave the first host and excavate later tunnels in a fresh host. Such procedure may require two or more years, the parent adults usually hibernating over the winter in the egg tunnels.

Although the galleries of a species are usually uniform in type they may vary due to obstructions, size of limb or trunk, proximity of other mines, etc. They also may vary somewhat regardless of the above. An example is cited by Kaston (39:6) who reports that in an examination of 1,745 galleries of Hylurgopinus rufipes (Eich.) he found that 82%, or 1,428, were biramous; 12%, or 221, were uniramous; 5.1%, or 89, were triramous, and 0.4% or 7, were quadriramous. The same is more or less true in the case of Alniphagus aspericollis.

Food Tunnels of the Adult Beetles

When adults are excavating their brood galleries, some of the excavated material is ingested and used for food. Some species extend the egg tunnel after the full complement of eggs have been deposited. This extension is for the purpose of obtaining food. Many species which reach maturity in the fall eat out from the pupal cells in food mines before emerging. They may be found extending food tunnels and feeding during warm spells, even in mid-winter.

Some species, especially of Scolytus and Phloeosinus, inflict some damage by burrowing in at the base of the buds, eating the bark or tunneling in twigs, and killing them. A number of species leave the tree in which they developed, seek a new host and excavate food tunnels. Such tunnels may be in the same part of the tree as the species normally attacks for rearing a brood, but more often they are in an entirely different portion of the host. Sometimes they may be in the same general region but not penetrate deep enough to have a serious effect upon the plant. For example, a species normally excavating its egg gallery in the cambium may dig a food gallery in the twigs, or it may enter the bark and confine its activities to the bark alone, not penetrating as far as the cambium.
Hibernation

Orr (35:1021) found that a very large percentage of the newly transformed adults of *Ips pini* (Say) and *I. grandicollis* (Eich.) leave their host trees late in the fall and go to the forest floor litter for winter hibernation. He also observed that where larva failed to transform to the adult stage before winter came, most succumbed, being unable to stand the rigors of the very cold Minnesota winters.

Keen (33:297) finds that large numbers of *Ips oregoni* (Eich.) and *I. emarginatus* emerge in the fall, drop to the ground and seek shelter in deep cracks or crevices of the bark, or excavate short hibernating tunnels into the bark near the ground level.

Clemens (16:292) states that in New York he found *Ips pini* hibernating in the adult stage and wintering between the bark and the wood, where the cambium had been more or less completely destroyed and the area filled with chips, sawdust, and frass.

Further south, Hopkins found *I. pini* and other species overwintering as adults, larvae, and even as pupae.

Various species of *Conophthorus* hibernate in the cones on the forest floor as adults. They may even pass two winters in the cone in which they developed.

*Alniphagus aspericollis* may pass the winter in specially constructed tunnels, fig. 11, bearing no resemblance to the design of the egg tunnels. *Dryocoetes septentrionis* (Mann.), often pass the winter in special tunnels excavated for that purpose. Such tunnels may be nearly one-quarter inch in diameter with 12 to 20 adult beetles crowded together at the end.

*Leperisinus oregonus* adults hibernate in individual galleries in limbs near the tree tops, selecting branches well covered by lichens for added protection.

*Pseudopityophthorus pubipennis* (Lec.) females overwinter in cracks and crevices of oak trees under the moss, *Dolurgus pumilus* (Mann.) has been found hibernating under moss and lichens on shore pine along the Oregon coast.

Fig. 11. *Alniphagus aspericollis* in hibernating tunnel
Polygraphus rufipennis may hibernate as a newly-transformed adult in the tree where it matured, emerging the following spring to mate and excavate one or more brood tunnels and then hibernate in a special gallery the second winter.

In the Willamette Valley of Oregon, Pseudohylesinus sericeus (Mann.), P. grandis Sw., Hylastes nigrinus (Mann.), and Hylurgops rugipennis (Mann.) have been found hibernating as adults in the thick moss which grows abundantly on the trunks of oak trees. Trees inhabited by the beetles were usually adjacent to stands of second growth Douglas-fir, in which all of the above species breed.

Mating

Mating probably occurs only once in most monogamous species, and usually on the bark of the host tree near the entrance tunnel, or in the tunnel where the turning niche is utilized in making contact. In species that pack the tunnel with frass and borings, the female dies at the far end and has no contact with the male after starting the egg tunnel; although occasionally the female will emerge and excavate a second, or rarely a third, egg gallery. The male, in these cases, is often found dead with his body blocking the entrance tunnel.

Polygamous species almost invariably have a central nuptial chamber from which individual egg galleries of the females radiate. These latter are usually kept clear, and the nuptial chamber may be visited from time to time by any of the females. Copulation occurs frequently. The same is true of many of the ambrosia beetles. Certain species of Anisandrus have males with undeveloped wings; therefore, mating must take place in the tunnels before the young females leave to start new galleries, since the males are unable to accompany the females, or seek them.

Though polygamous, the female of some species of Pityophthorus fills the egg gallery with frass and borings as she advances, hence she does not return to the nuptial chamber. The fertilization which occurred prior to starting her gallery must therefore suffice for her entire complement of eggs.

European writers report that certain species [Ips typographus (L.)] copulate frequently. Gossard (1913) reports that Phloeotribus liminaris (Harr.) also mates frequently during the construction of the gallery.

Blackman in his study of Pityogenes hopkinsi Sw. (15:32-33) was unable to determine whether this polygamous species mated more than once with the various females, although he did observe pairs mating.

Doane (29:916) states that Monarthrum scutellare (Lec.) copulates in the nuptial chamber as soon as the female has cut a secondary gallery, and that mating takes place several times during the construction of the mine.

The same author (p. 920) writing of Gnathotrichus sulcatus (Lec.), states, "Copulation takes place in the main and secondary galleries." Such a procedure would appear impossible since the galleries are barely large enough to allow the passage of the beetles. It is more likely that the pairs meet for mating at the junctures of such mines.
Trimble (1924) observed that *Ips radiatae* Hopk. and *I. plastographus* (Lec.) copulate only in the nuptial chamber.

**Number of Eggs**

According to the meager data available the number of eggs deposited by a given species is subject to considerable variation.

The lowest number we have found recorded is for *Hylastinus obscurus*, which according to various authors, deposits only 6 to 8 eggs. The opposite extreme is represented by *Dendroctonus ponderosae* Hopk. and *D. valens*, which deposit as many as 300 eggs.

*Ips plastographus* females deposit an average of 60 eggs each (Trimble 24: 386), with a maximum of 104. *Ips radiatae* deposit 4 eggs to each pocket, each female depositing an average of 90 eggs. The maximum number noted was 176 eggs.

Some of the small species deposit very large eggs for their size. We found this to be true in the case of *Taenioglyptes amabilis* and *T. ruficollis* (Hopk.). The number of eggs was very small however, with only 10 to 12 in each gallery. Doane reports that *Monarthrum seculare* deposits a maximum of 80 with an average of 50 eggs per female. According to Hopkins, *Corthylus columbianus* Hopk. produces only 10 to 12 eggs per gallery. Blackman found *Ips pini* produced from 38 to 55, with an average of 42 eggs per female. *Ips longidens* Sw. deposits 16 to 23, averaging 19.

Blackman (31:21) states that the total number of eggs produced by a single female of *Dendroctonus ponderosae* often exceeds 200 and may exceed 300. He found an average of 100.85 eggs per foot of gallery, and the average egg gallery measured 22 inches in length, giving an average of 184 eggs per gallery.

The same author (15:50) made counts of the number of egg niches in 66 galleries of *Pityogenes hopkinsi* and found the minimum to be 2, maximum 60, with an average of approximately 20 egg niches.

From counts made on a few galleries of some of our western species the following figures have been obtained.

<table>
<thead>
<tr>
<th>Species</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Average number of eggs</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Phloesinus rubicundulus</em> Blkm.</td>
<td>55</td>
<td>19</td>
<td>35.5 (12 galleries)</td>
</tr>
<tr>
<td><em>Phloesinus cristatus</em> Lec.</td>
<td>142</td>
<td>99</td>
<td>124 (7 galleries)</td>
</tr>
<tr>
<td><em>Phloesinus cupressi</em> Hopk.</td>
<td>146</td>
<td>55</td>
<td>96 (5 galleries)</td>
</tr>
<tr>
<td><em>Pseudohylesinus nebulosus</em> (Lec.)</td>
<td>98</td>
<td>70</td>
<td>81 (10 galleries)</td>
</tr>
<tr>
<td><em>Pseudohylesinus nobilis</em> Sw.</td>
<td>62</td>
<td>56</td>
<td>59 (4 galleries)</td>
</tr>
<tr>
<td><em>Scolytus unispinosus</em> Lec.</td>
<td>74</td>
<td>54</td>
<td>66 (6 galleries)</td>
</tr>
<tr>
<td><em>Pityophthorus pseudotsugae</em> Sw.</td>
<td>21</td>
<td>12</td>
<td>15 (4 galleries)</td>
</tr>
<tr>
<td><em>Renocis heterodoxus</em> Csy.</td>
<td>62</td>
<td>18</td>
<td>44 (52 galleries)</td>
</tr>
<tr>
<td><em>Pseudopityophthorpus pubipennis</em> Lec.</td>
<td>88</td>
<td>10</td>
<td>41.5 (46 galleries)</td>
</tr>
<tr>
<td><em>Leperisinus oregonus</em> Blkm.</td>
<td>133</td>
<td>10</td>
<td>49 (40 galleries)</td>
</tr>
</tbody>
</table>
Deposition of the Eggs

Eggs are deposited in several situations. The more common method is for the female to excavate small hemispherical cavities along each side of the egg gallery. These “egg niches” may be very regularly and closely placed, or they may be distinctly separated; they may be opposite each other, or alternate. A single egg is placed in each niche and carefully covered over. Conophthorus lambertianae, Hopk., Dendroctonus monticolae, Ips oregoni, Phylocoeus juniperi Sw., Scolytus ventralis, and Alniphagus aspericollis are examples of this type. Design, length, or situation of the gallery has no bearing upon the egg deposition nor does the practice of monogamy or polygamy determine this deposition, since we find several types in the same genus.

A variation of the “egg niche” is the egg pocket. In this type the niche is made larger with two to several eggs placed therein and covered over; Orthotomicus ornatus Sw. is an example.

Dendroctonus pseudotsugae Hopk. goes a little further in this direction and excavates egg grooves alternately along the sides of the main gallery. In these may be deposited 20 or more eggs, carefully partitioned off from the gallery. D. engelmanni Hopk. has similar habits.

In the cave type of tunnels any one of several methods of egg deposition may occur. Eggs may be deposited in more or less of a mass around the entire cave, or part way around, and covered with frass and borings, as in Dendroctonus valens. They may be few in number and deposited in clumps of 3 or 4 at intervals around the edge of the cave, as in Taenioglyptes amabilis. Renocis heterodoxus excavates short fingerlike tunnels, fig. 30, from the central chamber and deposits a number of eggs at the end of each lateral. In some ambrosia beetle tunnels the eggs are deposited in niches (Monarthrum scutellare), or may be deposited loosely in the caves or tunnels without any apparent system or order.

Seasonal History

As would be expected in a large group of insects distributed from the Arctic Circle to the Gulf of Mexico and found from sea level to 12,000 feet in altitude, great diversity occurs in the time required for brood development. Such variation is probably due more to latitudes and altitudes than to the species. This is exemplified by Dendroctonus brevicomis, which has only one generation in the high pine forests of British Columbia. Farther south, one complete, and a partial second brood will be found, and under very favorable conditions, two complete broods or even more will be evident in one year.

Ips confusus (Lec.) has a single generation at the northern limit of its range, while Burke (32.366) reports that under favorable conditions it has four generations in the lower elevations of California. Exceptional seasons often make a difference; for instance, the southern pine beetle is reported to normally produce 3 to 4 generations a year, but during years of very mild winters six complete generations will be produced.

In the far north Dendroctonus johanseni requires 2 to 3 years for a
Fig. 12. Life cycle of the Douglas-fir beetle (by Edmonson)
generation and *D. engelmanni* requires two years for its cycle at the higher elevations. *D. borealis, Polygraphus rufipennis*, and the few other species found in the extreme north also require two years to complete their cycles. By contrast, *Polygraphus rufipennis* may produce two or more generations per year in southern Oregon, California, or Arizona.

Time of attack is also variable. During the first warm days of spring, February in some sections of the Gulf states or July in high altitudes of the Rocky mountains or in the far north, individuals which hibernated as fully matured adults emerge. In a short time they mate, and the excavation of new galleries begins. Next to emerge are species which passed the winter as newly-formed adults in the old pupal cells; these are followed in order by individuals which may have overwintered as pupae; then the old, and later the young larvae; and last are those which wintered as eggs. It should be noted that in colder portions of our country few, if any, individuals winter as pupae or eggs.

Further south, any or all stages—eggs, larvae, pupae, or adults—may be found. Even in the more southern sections, however, the cold season is usually passed as young or old adults, or in the larval stage. A considerable number of species, *Polygraphus, Ips*, and others, deposit one complement of eggs and then hibernate over winter. In the spring they excavate a new brood tunnel and deposit another complement of eggs. Swaine and Simpson (1929) found that *Polygraphus rufipennis* excavated 4 or 5 sets of brood tunnels in the course of 1 year and part of 2 others, so the adults hibernated over 2 winters.

Attacks of various species will be evidenced, therefore, from the beginning of warm spring weather until the arrival of cold fall days. All species seem to have one, or several periods during spring, summer, or early fall which may be designated “peak periods” of emergence and attack. Not all species attack at once; in fact, many species emerging in late summer or fall make no attempt to excavate brood tunnels but hibernate in specially excavated hibernating tunnels, using the duff of the forest floor, or in deep crevices of bark under moss, or in similarly protected places. Some feed in the bark, dig special food tunnels, or use the buds and tender bark of their host plants as food before becoming sexually mature.

Some of the species of *Conophthorus* show a remarkable habit in that not all individuals of a brood will emerge the first year. A percentage always remains more or less dormant within the cones for an extra year, or even longer. Perhaps this wise provision of nature is to prevent species extinction, since it is unusual for some conifers to produce cones each year. If all adults of a given species emerged during a year when their host trees failed to produce cones in that area, the species would be subject to extinction. This may also account for some of these cone beetles occasionally being found mining in twigs.
Hosts of SCOLYTOIDEA

Most species of Scolytidae show a very decided preference for certain species of host plants, many refusing to enter any other variety. *Dendroctonus aedeagus* works only in Sitka spruce*, D. jeffreyi* is found only in Jeffrey pine. Other species will have a limited number of closely-related trees in which they breed, such as *D. brevicomis* which works in ponderosa pine and Coulter pine. The other extreme is represented by such species as *D. monticolae* and *D. valens* which attack all species of pine within their ranges and occasionally enter other conifers.

A whole genus may show a very definite affinity for a certain group of tree species. *Phloeosinus*, with few exceptions, breeds in conifers belonging to the Cupressaceae.

Besides selecting certain hosts, many species go much further by working only in restricted parts of that host. This is exemplified by the genus *Conophthorus* which ordinarily attacks only the cones; *Hylastes* and *Hylastinus*, which work largely in roots; *Dendroctonus valens* which is never found working more than a few feet above ground level. A large number of small species of *Pityophthorus*, *Carphoborus*, and others, work in twigs, tops, or small branches where the bark is very thin. It is also quite likely that various species may be influenced in their attack by the actual height above ground, the moisture content, and the bark texture, in selecting a point of entrance.

The plant’s physiological condition also determines, at least to some extent, what species will attack it. Some will concentrate on the finest trees of the stand; others attack only when the vitality of the tree has been severely lowered (many *Ips*, and most of the ambrosia beetles), and still others prefer to wait until the tree is dead (*Hylurgops*).

Once the tree is entered the point of gallery excavation is still a matter of distinction. It may lie entirely in the bark (some *Pseudopityophthorus*); in the cambium—where it may be almost entirely in the bark, engraving the wood but slightly; or it may so deeply engrave the wood that the outline scarcely shows on removed bark. The galleries often lie almost exactly half in the bark and half in the wood. A few species (*D. brevicomis* and *D. barberi* Hopk.) excavate egg or main tunnels in the cambium, but the larvae spend all their time excavating in the middle layers of bark.

Timber or ambrosia beetles work entirely in the wood, except for their entrance tunnel through the bark to reach the wood. Their mines may either be confined to the sapwood, or may enter the heartwood. Some twig borers also excavate their mines largely in the soft, pithy wood of the twigs, or even in dead, dry twigs.

* *Scientific and common names used are those used in Check List of . . . Trees of the United States by E. L. Little and associates. Agricultural Handbook No. 41. Forest Service 1953.*
SCOLYTOIDEA and Fungi

Various species of Scolytoidea are intimately associated with certain species of fungi that may be divided into various groups for convenience.

1. Those fungi which are introduced into the cambium by the beetles, hasten the death of the tree and damage the commercial value of the wood by staining it blue or brown.
2. Fungi similar to the above causing a disease which kills the tree; the Dutch elm disease fungus.
3. Fungi used as food by the insects; various species of ambrosia fungus.
4. Fungi beneficial to man because they attack and kill the beetle broods; the entomogenous fungi.
5. A few other fungi not falling into any of the above classes.

Interrelationship of Bark Beetles and Wood Staining Fungi

Rumbold (1931) very aptly states that, “The relation between bark beetles and blue-stain fungi has become a matter of economic interest in the United States. The insects annually infest many trees, and after their attack, a blue stain rapidly develops in the sapwood. Such infestation results in the death of the trees, usually within a short time, and it is probable that the blue stain contributes to their death. Even though the trees may be felled soon after the insect attack, the stained sapwood reduces the commercial value of the lumber cut from them.”

Craighead had previously (1928) pointed out that the blue-stain probably contributed to the more rapid death of the trees stating: “The question of how these beetles kill the tree so completely and quickly is one that has attracted the interest of all those familiar with their habits. The usually-accepted theory that death of the tree results from completely girdling the cambium and phloem by means of the egg tunnels, made by the adults, and the larval mines does not seem to be a wholly adequate answer. This rapid death can be illustrated by a comparison as follows: Trees attacked by the summer generations of some species of Dendroctonus may show fading foliage within three weeks after attack, while trees mechanically girdled by removing the bark from portions or the entire main stem may live from six months to a year or more and continue to add annual layers of wood on those portions above the girdle.”

In the United States, Von Schrenk (1903) was the first to show a connection between the infestation of bark beetles and blue-stain. His observations were made on Pinus ponderosa, infested with Dendroctonus ponderosae.

Nelson and Beal (1929) quite conclusively proved that bark beetles were a factor in the spread of blue-stain fungus. Of the 218 zones of blue-stain in short leaf pine, (Pinus echinata), they found that 97% were directly associ-
ated with the entrance hole of the beetle, *Dendroctonus frontalis*. They say, "Blue-stain in southern pines, except in association with beetle attack, is uncommon, although it is occasionally found in pines which have been severely wounded, such as in dry faces of turpentine trees."

**Introduction of Blue-Stain by Bark Beetles**

Fungi are introduced by either male or female beetles, and the spores begin to grow in the inner bark and sapwood soon after introduction.

Blue-staining fungi sporulate profusely during the bark beetles’ occupation. When moisture conditions are favorable, spores ooze from the tips in sticky masses. Examination of the beetles' intestinal tract contents shows that ascospores and even parts of the perithecia are eaten. These bear no signs of injury, and germination experiments show that they are still viable after passage through the body of the beetle.

The “blue” fungus seems to start at various points along a beetle tunnel; in other words, it does not grow down into the mine from the outside.

**Damage Caused by Blue-Stain**

Such reliable strength tests as have been made indicate a very slight weakening effect due to blue-stain. The weakening is, in itself, of no special importance in larger material, but it serves to hide the effect produced by wood-destroying fungi which often accompany it.

The blue-staining fungi, by inhibiting the sap flow, in all probability make living trees more favorable for beetle development. By aiding in the decomposition of the inner bark they cause it to separate from the wood, creating a more favorable environment for development of the insect broods.

**Brown-Staining Fungi and Bark-Beetles**

Wright (38:759) described a fungus, *Trichosporium symbioticum*, which is commonly associated with *Scolytus ventralis* in *Abies concolor*. The same author identified *Spicaria anomala* (Corda) as the fungus commonly associated with *Scolytus subscaber* Lec. and *S. praeceps* Lec. in various species of *Abies*. Both species of fungus stain the wood brown, kill the tree cambium, and materially reduce the moisture content in the immediate environment. Thus, these fungi materially aid the insects in their destructive work.

Spores of the fungi are evidently introduced by the beetles in the same manner as species of *Dendroctonus* introduce the blue-stain fungus spores.
Interrelationship of Ambrosia Fungi and Timber Beetles

One group of *Scolytidae* is commonly called ambrosia beetles because both larvae and adults feed upon ambrosia fungi. Hubbard (1897) demonstrated that each beetle species cultivates a different species of fungus as a rule, and that only very closely related species will feed upon the same species of fungus. This author further states that there are two types of fungus found in the timber beetle galleries:

1. "Those with erect stems, having at the termination of the stems or their branches swollen cells."
2. "Those which form tangled chains of cells resembling the piled-up beads of a broken necklace."

The first form is commonly found in galleries of species whose larvae live free in the galleries, i.e. *Platypus, Xyleborus*, etc. bead-like forms occur in those galleries where young are reared in cradles, *Trypodendron, Monarthrum, Gnathotrichus*, etc.

In order to keep the fungus succulent, it is necessary that it be cropped off constantly and not allowed to ripen. Unless the crop is kept regularly under control, it will mature and increase at such a rapid rate that it will suffocate the entire colony by choking the tunnels with its own growth.

Introduction of the fungus into the gallery is not accidental, but is a deliberate action of the beetles. The manner of transportation of the spores of ambrosia has had various explanations, such as: (a) voided by the beetles in the excreta, (b) carried in the crop of the female and regurgitated when the beds have been prepared, (c) carried in the brush of hairs on the front of the head, (d) carried under the elytra, and (e) carried in special pores.

Beeson (Indian Forest Records 1917, vol. 6) reports that in the case of *Platypodidae* there are large prothoracic pores which contain globules of fat to which the fungus spores readily adhere, and when the beetle is well established they germinate and separate from the insect.

Hubbard (1908) states that the spores are carried in various ways—in the hairs, under the wings, or internally—from the galleries in which the beetles were reared. These spores are planted and carefully tended in the new home. In some cases excrement of the beetles and also of the larvae is used to fertilize the fungus gardens. The moisture content of the wood itself must be sufficient to grow the fungus, otherwise the insects will leave. Due to this fact, moisture content of the wood is a limiting factor regarding trees, logs, stumps, or other wood that the insects will attack, and it also limits the length of time that broods will be reared in that particular gallery.
### Table 1

**The Scolytoidea of the Northwest with their Distribution and Hosts**

*The numbers in the right column refer to the numbered list of trees following this table. Where a question mark appears, it indicates the probable presence of the species.*

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Oregon</th>
<th>Washington</th>
<th>British Columbia</th>
<th>Idaho</th>
<th>Western Hosts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Family PLATYPODIDAE.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. <strong>PLATYPUS</strong></td>
<td>wilsoni Sw.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>Most conifers</td>
</tr>
<tr>
<td>2. <strong>SCOLYTUS</strong></td>
<td>multistriatus Marsh.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>sobrinus Blkm.</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>unispinosus Lec.</td>
<td>type</td>
<td>x</td>
<td>x</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ventralis Lec.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td></td>
<td>subscaber Lec.</td>
<td>x</td>
<td>type</td>
<td>x</td>
<td>2, 3, 5, 14, 31</td>
<td></td>
</tr>
<tr>
<td></td>
<td>monticolae Sw.</td>
<td>x</td>
<td>x</td>
<td>type</td>
<td>x</td>
<td>1, 3, 6, 29, 31, (36?)</td>
</tr>
<tr>
<td></td>
<td>rugulosus Ratz.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>Fruits and other broad leaf trees.</td>
</tr>
<tr>
<td></td>
<td>tsugae Sw.</td>
<td>x</td>
<td>x</td>
<td>type</td>
<td>x</td>
<td>3, 31, 35, 36</td>
</tr>
<tr>
<td></td>
<td>praeceps Lec.</td>
<td>x</td>
<td></td>
<td>x</td>
<td>2, 3, 31, 36</td>
<td></td>
</tr>
<tr>
<td></td>
<td>oregoni Blkm.</td>
<td>type</td>
<td></td>
<td>?</td>
<td>2 and 31</td>
<td></td>
</tr>
<tr>
<td></td>
<td>larchis Blkm.</td>
<td>x</td>
<td>x</td>
<td>type</td>
<td>13 and 14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>piceae Sw.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td><em>Abies balsamea</em>, 12, any <em>Picea</em>.</td>
</tr>
<tr>
<td></td>
<td>abietis Blkm.</td>
<td>x</td>
<td>x</td>
<td>?</td>
<td>type</td>
<td>1, 3, and 36</td>
</tr>
<tr>
<td><strong>3. CRYPTURGUS</strong></td>
<td>borealis Sw.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>4, 6, 12, 13, 17, 29, 31, 36</td>
</tr>
<tr>
<td><strong>4. DOLURGUS</strong></td>
<td>pumilus (Mann.)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>3, 17, 19, 29, 31, and <em>Pinus muricata</em>.</td>
<td></td>
</tr>
<tr>
<td><strong>5. POLYGRAPHUS</strong></td>
<td>rufipennis (Khy.)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td><em>Picea, Larix, Pinus</em>, 31</td>
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<tr>
<td></td>
<td>convexifrons Wood.</td>
<td></td>
<td></td>
<td>x</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td><strong>6. RENOCIS</strong></td>
<td>heterodoxus Csy.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>43, 48, 49, 50 <em>Prunus</em>, apple</td>
</tr>
<tr>
<td><strong>7. CARPHORUS</strong></td>
<td>pinicola Wood.</td>
<td></td>
<td></td>
<td></td>
<td>?</td>
<td>Pines within its range</td>
</tr>
</tbody>
</table>
### Table 1—(Continued)
The Scolytidea of the Northwest with their Distribution and Hosts*

<table>
<thead>
<tr>
<th>Species</th>
<th>Oregon</th>
<th>Washington</th>
<th>British Columbia</th>
<th>Idaho</th>
<th>Western Hosts</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>vandykei</em> Bruck</td>
<td>x</td>
<td>?</td>
<td>x</td>
<td></td>
<td>31</td>
</tr>
<tr>
<td><em>ponderosae</em> Sw</td>
<td>x</td>
<td>?</td>
<td>x</td>
<td></td>
<td>23, 30</td>
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<tr>
<td><em>intermedius</em> Wood</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td>17, 23</td>
</tr>
<tr>
<td>8. <em>pitthorophloeus</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>puberulus</em> (Lee.)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>3, 17, 30, 31</td>
</tr>
<tr>
<td>9. <em>dendroctonus</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>brevicornis</em> Lee.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>23, 26, 30</td>
</tr>
<tr>
<td><em>monticolae</em> Hopk</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td>type</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>All species of <em>Pinus</em> in its range; rarely 17, 35</td>
</tr>
<tr>
<td><em>jeffreyi</em> Hopk</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td><em>murrayanae</em> Hopk</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>23</td>
</tr>
<tr>
<td><em>valens</em> Lee</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>All pines within its range, rarely other conifers</td>
</tr>
<tr>
<td><em>engelmanni</em> Hopk</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>16, 17, 23, <em>Picea pungens</em></td>
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<tr>
<td><em>obesus</em> (Mann.)</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td><em>pseudotsugae</em> Hopk</td>
<td>type</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>31; rare in 14, 35, 36 <em>Pseudotsuga macrocarpa</em> in Calif.</td>
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<td><em>borealis</em> Hopk</td>
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<td></td>
<td></td>
<td>x</td>
<td>17, <em>Picea canadensis</em></td>
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<td>10. <em>phloeosinus</em></td>
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<tr>
<td><em>antennatus</em> Sw</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td><em>vandykei</em> Sw</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>15 and 34</td>
</tr>
<tr>
<td><em>buckhorni</em> Blkm</td>
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<td></td>
<td></td>
<td></td>
<td>15 and 34</td>
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<td></td>
<td></td>
<td></td>
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<td><em>fulgens</em> Sw</td>
<td>x</td>
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<td></td>
<td></td>
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</tr>
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<td><em>juniperi</em> Sw</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><em>scopulorum</em> Sw</td>
<td>x</td>
<td>type</td>
<td></td>
<td>?</td>
<td>11 and 34</td>
</tr>
<tr>
<td><em>nitidus</em> Sw</td>
<td>type</td>
<td></td>
<td></td>
<td>x</td>
<td>8</td>
</tr>
<tr>
<td><em>punctatus</em> Lee</td>
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<td>x</td>
<td>x</td>
<td>x</td>
<td>10, 15, 34, (7?), and (8?)</td>
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### Table 1—(Continued)
The Scolytoidea of the Northwest with their Distribution and Hosts*

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<thead>
<tr>
<th>Scolytoidea</th>
<th>Oregon</th>
<th>Washington</th>
<th>Columbia</th>
<th>Idaho</th>
<th>Western Hosts</th>
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<td></td>
<td></td>
<td></td>
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</tr>
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<td>sequoiae Hopk.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>7, 10, 15, 32, 33, and 34</td>
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<tr>
<td>hoffingi Sw.</td>
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<td>?</td>
<td>x</td>
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<td>11 and 15</td>
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<td>rusti Blkm.</td>
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<td>x</td>
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<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>rubicundulus Sw.</td>
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<td>?</td>
<td>x</td>
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<td>7, 15, and 32</td>
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<td>kaniksu Blkm.</td>
<td>x</td>
<td>type</td>
<td>?</td>
<td>x</td>
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<td></td>
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<td>x</td>
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<tr>
<td>annectens Lec.</td>
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<td>x</td>
<td>x</td>
<td>x</td>
<td>4, 17, 19, 23, and Picea</td>
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<td>x</td>
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<td></td>
<td>4, 16, and 17</td>
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<td>alniphagus aspericollis (Lec.)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>40 and 41</td>
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<td>hylastinus obscurus (Marsh.)</td>
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<td>x</td>
<td>x</td>
<td>x</td>
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<td>x</td>
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<td>x</td>
<td>1, 2, 3, 4, 5, 31, and 35</td>
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<td>dispar Blkm.</td>
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<td>x</td>
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<td>type</td>
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</tr>
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<td></td>
<td></td>
<td></td>
<td>35</td>
</tr>
<tr>
<td>furnissi Blkm.</td>
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<td></td>
<td>1 and 3</td>
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<td>Washington</td>
<td>British Columbia</td>
<td>Idaho</td>
<td>Western Hosts</td>
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<td>------------------</td>
<td>-------</td>
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<tr>
<td>sitchensiis Sw.</td>
<td>x</td>
<td>x</td>
<td>type</td>
<td></td>
<td>19 and 20</td>
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<td></td>
<td>type</td>
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<td>unrecorded</td>
</tr>
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<td>pullatus Blkm.</td>
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<td>similis Blkm.</td>
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<td>17. Hylostes ruber Sw.</td>
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<td>x</td>
<td>x</td>
<td>x</td>
<td>4, 14, 29, 31, and 35</td>
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<tr>
<td>macer Lee.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>17, 25, 26, and 30</td>
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<tr>
<td>gracilis Lee.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>2, 4, 26, 27, and 30</td>
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<td>longicollis Sw.</td>
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<td>lecontei Sw.</td>
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<td>x</td>
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<td>parosus (Lee.)</td>
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<td>x</td>
<td>x</td>
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<td>23 and 29</td>
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<td>19. Michalis hirtellus Lee.</td>
<td>x</td>
<td>x</td>
<td></td>
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<td>Many hardwood trees and shrubs</td>
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<tr>
<td>20. Trypodendron lineatum (Oliv.)</td>
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<td>x</td>
<td>x</td>
<td>x</td>
<td>Most conifer species</td>
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<tr>
<td>rufiarsis (Kby.)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>23, 30, 31, and Picea spp.</td>
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<tr>
<td>retusum (Lee.)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>53</td>
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<tr>
<td>21. Monarthrum scutellare (Lee.)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td>56</td>
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<tr>
<td>22. Cyprialis nitidus (Sw.)</td>
<td></td>
<td></td>
<td>x</td>
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<td>Alnus spp. &amp; Salix spp.</td>
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<tr>
<td>salicis (Hopk.)</td>
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<td>x</td>
<td></td>
<td></td>
<td>Alnus spp. &amp; Salix spp.</td>
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<tr>
<td>23. Taenioglyptes pubescens (Hopk.)</td>
<td>x</td>
<td>type</td>
<td>x</td>
<td>x</td>
<td>3, 4, 26, 31, and 33</td>
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</tbody>
</table>
**Table 1—(Continued).**

*The Scolytidae of the Northwest with their Distribution and Hosts*

<table>
<thead>
<tr>
<th>Species</th>
<th>Oregon</th>
<th>Washington</th>
<th>British Columbia</th>
<th>Idaho</th>
<th>Western Hosts</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>amabilis</em> (Chamb.)</td>
<td>type</td>
<td>x</td>
<td></td>
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<td>1, 4, 5, and 31</td>
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<td><em>ruficollis</em> (Hopk.)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>1, 3, 4, 5, 16, and 17</td>
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<td><strong>24. POCYMYHALUS</strong></td>
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<td>x</td>
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<td><strong>25. GNATHOTRICHUS</strong></td>
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<td><em>retusus</em> (Lec.)</td>
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<td>3, 5, 19, 31, 33, 34, 35, 36, and 20</td>
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<td><em>sulcatus</em> (Lec.)</td>
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<td>x</td>
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<td>Most conifers within range</td>
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<td><em>alni</em> Blkm.</td>
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<td><em>ponderosae</em> Hopk.</td>
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<td>30 and rarely in 25</td>
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<td>x</td>
<td>type</td>
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<td><em>contortae</em> Hopk.</td>
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<td><strong>27. MYELOBORUS</strong></td>
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<td>24 and <em>Pinus strobiiformis</em></td>
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### Table 1—(Continued)
The Scolytoidae of the Northwest with their Distribution and Hosts*

<table>
<thead>
<tr>
<th>Species</th>
<th>Oregon</th>
<th>Washington</th>
<th>British Columbia</th>
<th>Idaho</th>
<th>Western Hosts</th>
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<td>x</td>
<td>25, 26, 30, and (31?)</td>
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<td>Rhus copallina and R. trilobata</td>
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<td>17 and Abies balsamea</td>
</tr>
<tr>
<td>intextus</td>
<td>type</td>
<td></td>
<td></td>
<td></td>
<td>13, 14, 16, and 17</td>
</tr>
<tr>
<td>ponderosae</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>

30. Ips

<table>
<thead>
<tr>
<th>Species</th>
<th>Oregon</th>
<th>Washington</th>
<th>British Columbia</th>
<th>Idaho</th>
<th>Western Hosts</th>
</tr>
</thead>
<tbody>
<tr>
<td>pilifrons</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>confinis (Lec.)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>Pinus spp.</td>
</tr>
<tr>
<td>montanus (Eich.)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>19, 23, 26, and 29</td>
</tr>
<tr>
<td>engelmanni Sw.</td>
<td>x</td>
<td>x</td>
<td>type</td>
<td></td>
<td>17 and Picea canadensis</td>
</tr>
<tr>
<td>emarginatus (Lec.)</td>
<td>type</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>23, 25, 26, and 30</td>
</tr>
<tr>
<td>guildi</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td>23 and 30</td>
</tr>
<tr>
<td>latidens (Lec.)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>Pinus spp.</td>
</tr>
<tr>
<td>oregoni (Eich.)</td>
<td>type</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>20</td>
</tr>
<tr>
<td>plastographus (Lec.)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>14, 23, 27, 29, and 30</td>
</tr>
<tr>
<td>radiatae Hopk.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>Most species Pinus in range</td>
</tr>
<tr>
<td>concinnus (Mann.)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>19</td>
</tr>
<tr>
<td>interruptus (Mann.)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>19, Picea canadensis, rare in 31</td>
</tr>
</tbody>
</table>
### TABLE 1—(Continued)
The Scolytoidae of the Northwest with their Distribution and Hosts*

<table>
<thead>
<tr>
<th>Species</th>
<th>Oregon</th>
<th>Washington</th>
<th>British Columbia</th>
<th>Idaho</th>
<th>Western Hosts</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>interpunctus</em> (Eich.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17 and 19; (23?) and (30?)</td>
</tr>
<tr>
<td><em>perturbatus</em> (Eich.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16, 17, 19, <em>Picea condenensis</em>, <em>Abies</em> and <em>tsuga</em>?</td>
</tr>
<tr>
<td><em>borealis</em> Sw.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4 and 17</td>
</tr>
<tr>
<td><em>yohoensis</em> Sw.</td>
<td></td>
<td></td>
<td>type</td>
<td></td>
<td>17</td>
</tr>
<tr>
<td><em>swainei</em> Hopping</td>
<td></td>
<td></td>
<td>type</td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>31. <em>pityogenes</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>carinulatus</em> (Lec.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>knechteli</em> Sw.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>fossilifer</em> (Lec.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32. <em>pityoctenes</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>elegans</em> Sw.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>minutus</em> (Sw.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33. <em>orthotomicus</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Report from spruce, larch, and pine</td>
</tr>
<tr>
<td><em>vicinus</em> (Lec.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>mantius</em> Sw.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34. <em>orthotomides</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>laurocarpi</em> (Sw.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4 and <em>Larix americana</em></td>
</tr>
<tr>
<td>35. <em>aniandrus</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>pyri</em> (Peck)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fruits and other broad-leaf trees</td>
</tr>
<tr>
<td>36. <em>xyloborus</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>saxicenii</em> Ratz.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><em>Quercus</em>, <em>Fagus</em>, <em>Betula</em> <em>Acer</em> and various fruit trees, also several conifers</td>
</tr>
<tr>
<td>37. <em>dryocoetes</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>confusus</em> Sw.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4, 6, <em>Abies</em> spp.</td>
</tr>
<tr>
<td><em>affiger</em> (Mann.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4, 17, 19, 29, and 31</td>
</tr>
<tr>
<td><em>septentrionalis</em> (Mann.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16, 17, 19, 31, <em>Abies</em> spp.</td>
</tr>
<tr>
<td><em>sechelti</em> Sw.</td>
<td></td>
<td></td>
<td>type</td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>
Coniferous Trees of the Northwest Which Serve as Hosts for One or More Species of Scolytidae.

1. *Abies amabilis* (Dougl.) Pacific silver fir*
2. *Abies concolor* (Gord. and Glend.) White fir
3. *Abies grandis* (Dougl.) Grand fir
4. *Abies lasiocarpa* (Hook.) Subalpine fir
5. *Abies magnifica* A. Murr. California red fir
7. *Chamaecyparis lawsoniana* (A. Murr.) Port-Orford-cedar
8. *Chamaecyparis nootkatensis* (D. Don.) Alaska-cedar
9. *Juniperus spp* Juniper
10. *Juniperus occidentalis* Hook. Western juniper
11. *Juniperus scopulorum* Sarg. Rocky Mountain juniper
12. *Larix laricina* (Du Roi) Tamarack
14. *Larix occidentalis* Nutt. Western larch
17. *Picea engelmannii* Parry. Engelmann spruce
18. *Picea mariana* (Mill.) Black spruce
19. *Picea sitchensis* (Bong.) Sitka spruce
20. *Pinus spp* Pines
23. *Pinus contorta* Doug. Lodgepole pine
27. *Pinus edulis* Engelm. Pinyon
29. *Pinus monticola* Doug. Western white pine
31. *Pseudotsuga menziesii* (Mirb.) Franco (P. taxifolia) Douglas-fir
32. *Sequoia gigantea* (Lindl.) Giant sequoia-redwood
33. *Sequoia sempervirens* (D. Don) Coast redwood
34. *Thuja plicata* Donn. Western redcedar
35. *Tsuga heterophylla* (Raf.) Western hemlock
36. *Tsuga mertensiana* (Bong.) Mountain or black hemlock

Broadleaf Trees and Shrubs Which Serve as Hosts of Scolytidae in the Northwest

<table>
<thead>
<tr>
<th>No.</th>
<th>Species</th>
<th>Common Name</th>
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</thead>
<tbody>
<tr>
<td>37</td>
<td>Acer circinatum Pursh.</td>
<td>Vine maple</td>
</tr>
<tr>
<td>38</td>
<td>Acer glabrum Torr.</td>
<td>Rocky Mountain maple</td>
</tr>
<tr>
<td>39</td>
<td>Acer macrophyllum Pursh.</td>
<td>Bigleaf maple</td>
</tr>
<tr>
<td>40</td>
<td>Alnus rhombifolia Nutt.</td>
<td>White alder</td>
</tr>
<tr>
<td>41</td>
<td>Alnus rubra Bong. (A. oregoni)</td>
<td>Red alder, Oregon alder</td>
</tr>
<tr>
<td>42</td>
<td>Alnus sinuata (Reg.) (A. sitchensis)</td>
<td>Sitka alder</td>
</tr>
<tr>
<td>43</td>
<td>Amelanchier florida Lindl.</td>
<td>Pacific serviceberry</td>
</tr>
<tr>
<td>44</td>
<td>Arbutus menziesii Pursh.</td>
<td>Pacific madrone</td>
</tr>
<tr>
<td>45</td>
<td>Betula occidentalis Hook.</td>
<td>Water birch</td>
</tr>
<tr>
<td>46</td>
<td>Betula papyrifera Marsh.</td>
<td>Paper birch</td>
</tr>
<tr>
<td>47</td>
<td>Celtis spp.</td>
<td>Hackberry</td>
</tr>
<tr>
<td>48</td>
<td>Cercocarpus betuloides Nutt.</td>
<td>Birchleaf cercocarpus, mountain mahogany</td>
</tr>
<tr>
<td>49</td>
<td>Cercocarpus breviflorus A. Gray</td>
<td>Hairy cercocarpus</td>
</tr>
<tr>
<td>50</td>
<td>Cercocarpus ledifolius Nutt.</td>
<td>Curlleaf cercocarpus</td>
</tr>
<tr>
<td>51</td>
<td>Fraxinus spp.</td>
<td>Ash</td>
</tr>
<tr>
<td>52</td>
<td>Fraxinus latifolia Benth. (F. oregona)</td>
<td>Oregon ash</td>
</tr>
<tr>
<td>53</td>
<td>Populus spp.</td>
<td>Poplar or cottonwood</td>
</tr>
<tr>
<td>54</td>
<td>Populus tremuloides Michx.</td>
<td>Quaking aspen</td>
</tr>
<tr>
<td>55</td>
<td>Populus trichocarpa Torr. &amp; Gray.</td>
<td>Black cottonwood</td>
</tr>
<tr>
<td>56</td>
<td>Quercus spp.</td>
<td>Oak</td>
</tr>
<tr>
<td>57</td>
<td>Quercus garryana Doug.</td>
<td>Oregon white oak, Garry oak</td>
</tr>
<tr>
<td>58</td>
<td>Quercus kelloggii Newb.</td>
<td>California black oak, Kellogg oak</td>
</tr>
<tr>
<td>59</td>
<td>Salix spp.</td>
<td>Willow</td>
</tr>
<tr>
<td>60</td>
<td>Ulmus spp.</td>
<td>Elm</td>
</tr>
</tbody>
</table>
Families of the Superfamily SCOLYTOIDEA

The superfAMILY Scolytoidae is readily separated into two families.
Anterior tarsi with segment 1 longer than segments 2, 3, and 4 combined; head as wide as thorax and visible from above ..........PLATYPODIDAE
Anterior tarsi with segment 1 shorter than 2, 3, and 4 combined; head often invisible from above and never as wide as thorax.........SCOLYTIDAE.

Family PLATYPODIDAE Chapius

Members of this family are easily separated from the Scolytidae by the characters given in the key. They are essentially tropical insects; only five species are known in the United States and a single species occurs in the Northwest.

The one genus found in North America is:

1 Genus PLATYPUS Herbst. 93:128

Platypus wilsoni Swaine 16:97

The pronotum of the male fig. 13 has a distinct medium line but lacks the densely punctured medium area of the female. Elytra with strongly produced, divergent, emarginate apices. Strial punctures coarser.

In the female (fig. 13a) the frons is broadly and deeply excavated, densely granulate-punctate; epistomal margin nearly straight with a small medial lobe, clothed above with orange setae. Length 5 to 5.7 mm.

Type locality: Campbell River, British Columbia.

Fig. 13a. Adult male and female of Platypus wilsoni (By Hayes)
THE SCOLYTOIDEA OF THE NORTHWEST

Distribution: Generally distributed in coniferous areas of British Columbia, south through the Pacific Coast States and Idaho.

Hosts: All Platypus are ambrosia beetles and work in fresh-cut, weakened, dying, or occasionally healthy specimens of all Pacific Coast conifers (except the Cupressine group and rarely the pines). Injury is chiefly to unprotected logs and sometimes fire damaged trees which might otherwise recover.

Tunnels are round and winding, and penetrate from 5 to 30 cm. into the sap- and heartwood. Borings are characteristic, being in the form of tiny splinters.

P. wilsoni is found abundantly in the same trees with Gnathotrichus sulcatus and G. retusus, and has similar habits, though its tunnels are slightly larger and deeper.

In Canada it has been found that the time of felling trees has some effect on the immunity of logs to P. wilsoni. The insects are not flying in coastal regions from October to March. During this period logging can be carried on without risk of infestation, but the first week in April is the last safe date.

The species is not of great importance since they seldom attack healthy trees. When they do attack in numbers, however, any target tree is injured beyond recovery.

Family SCOLYTIDAE Geoffroy

This family includes all but five (Platypus) of the North American species belonging to the superfamily. The Scolytidae is made up of 5 subfamilies, 73 genera, and approximately 630 species.

In spite of the large number of species and their diversity of habits, they are quite constant as to morphological characters.

EXTERNAL ANATOMY

The more salient characters of the external structure are shown in the accompanying plates, I and II.

Adults are all small in size, ranging from less than 1 millimeter in length, Hypothemenus spp., to Dendroctonus valens which attains a length of nearly 10 millimeters. For the most part they are cylindrical, occasionally semi-oval (Anisandrus male), range in color from a reddish-brown, to dark-brown, to black, and are usually unicolored, though a few species show variegated markings. Trypodendron lineatum shows light amber stripes on the elytra; some Phthorophilus, Leperisinus, and Pseudohylesinus are covered with scales and show distinctly variegated color markings. The body may be smooth and shining (Trypodendron); or covered with minute hairs, bristles, or scales; or may be roughened with elevated striae. Generally the posterior is covered by the elytra. The elytral declivity may be rounded (Dendroctonus) or concave (Ips) and often presents spines or tubercles (Ips, Pityogenes, etc.). In a few genera (Scolytus) the elytra do not cover the posterior end but stop
THE SCOLYTOIDEA OF THE NORTHWEST

abruptly at the posterior dorsal margin with the exposed abdominal segments in such cases often bearing one or more prominent tubercles or spines. The pronotum may be smooth and shining (*Anisandrus*), or decidedly roughened (*Cryphalus*, *Pityophthorus*, etc.).

The head is usually entirely hidden in the prothorax, although it is partially visible from above in some genera (*Dendroctonus*). Chewing mouth parts have well developed mandibles, rigid palpi of three segments and a total lack of a labrum.

Antennae (Plate II, A.) are elbowed at the middle (geniculate) and except for a single genus (*Phthorophloeus*) have a more or less compact club at the tip. The scape is short to medium long and the antennal funicle is made up of 1 to 7 segments. The club is extremely variable and is probably the most important single character used in taxonomy (figs. 14 and 15). It may be distinctly annulated (*Pityophthorus*), or of a single segment (*Chramesus*), it
A) Nomenclature of the dorsal aspect of *Dendroctonus valens* 
(After Hopkins in part)

B) Nomenclature of the lateral aspect of *Dendroctonus valens* 
(After Hopkins in part)
PLATE II

A) Nomenclature of the antenna
B) Nomenclature of the ventral aspect of *Dendroctonus valens* (After Hopkins in part)
may be triangular (Crypturgus), oval (Cryptalus), elongate, narrow (Leperisinus), or reniform (Chramesus). The vestiture may be short and uniform (Scolytus), or there may be scattered long hairs or bristles as in some Ips, Micracis, and Monarthrum; the hairs may be barbed as in Pseudohylesinus and Carphoborus, or spatulate as in some Phloeosinus.

The abdomen is completely covered by the elytra above, but has five visible segments beneath. These may ascend abruptly (Scolytus) or may be horizontal to the end.

The legs are important from a taxonomic standpoint. They are of the ordinary insect type consisting of coxa, trochanter, femur, tibia, and a tarsus of five segments. The first segment is short, fourth often very small, the third often somewhat expanded laterally and the fifth long, terminating in two claws. The tibia may be simple, compressed, and slightly dilated near the end with a serrate outer margin, or short and broad with parallel margins, and devoid of teeth as in Scolytus and Micracis. The outer end may be cut off square, rounded, or may be prolonged into a distinct, curved spine.

Many species have little or no outstanding differences between the sexes; however, in Anisandrus the males are often dwarfed, hump-backed, and without flying wings; in Phthorophloeus the head is often bi-spinose; in Carphoborus the male has two tubercles on the head while the female has only one. The number, situation, and length of hairs on the antennae and the elytral declivity—as well as the density of the punctuation on various parts help differentiate the sexes. In Pityogenes the male is easily identified by the presence of blunt tubercles on the declivity (fig. 103) and in Orthotomicus the male has large tubercles on the declivity while the females have none.

The eggs are very small, round to oval, white, milky white, or bluish white, and though small, are very large in some cases when compared to the
female depositing them. This is especially noticeable in some of the small species such as *Taenioglyptes amabilis*.

The larva (fig. 34) is without legs; the head is distinct, with well-developed mandibles. The cylindrical body lies in a crescentic position when removed from the gallery and is deeply wrinkled, white or yellowish, and often has numerous hairs and spines.

Pupae are white when first transformed, later turning to a yellowish color. In transforming to the adult the dark color shows first in mandibles and eyes, then gradually extends toward the anal end. The antennae, wing pads, and legs are plainly visible on fully formed pupae. In some cases hairs and spines are quite conspicuous on various parts of the body.

Type of the family is *Bostrichus scolytus* Fabricius.

Members of this family are easily distinguished from the Platypodidae by the tarsal and head characters given in the key.

The North American species of the family are divided into 5 subfamilies, 4 of which are represented in the Northwest and may be separated as follows:

Key to the subfamilies of SCOLYTIDAE found in the Northwest

1. Anterior tibiae produced into a prominent process at the outer apical angle, SCOLYTINAE .............. p. 40
   Anterior tibiae not so produced ............. 2

2. Head partially visible from above and pronotum rarely strongly roughened in front, HYLESININAE ........ p. 51
   Head concealed from above and pronotum usually distinctly roughened in front --------------------------------- 3

3. Anterior tibiae with nearly parallel sides, not distinctly widened at the tip; antennal funicle usually of six segments, MICRACINAE ..... p. 120
   Anterior tibiae widened distally and serrate on the outer margin; antennal funicle with less than six segments, IPINAE .............. p. 122
THE SCOLYTOIDEA OF THE NORTHWEST

Subfamily SCOLYTINAE

The Scolytinae are mainly tropical in their distribution. There are species of five genera found in America (north of Mexico); four of these are represented in the United States by a single species. The fifth genus, Scolytus, is widely distributed and species attack either broadleaf trees or conifers. It is well represented in the Northwest.

2 Genus Scolytus Geoffroy 62:309

The most recent revisional study of the genus Scolytus is that by Blackman (1934) wherein he lists 23 species. That author also straightened out the mystery concerning LeConte's species. S. californicus Lec, which proved to be synonymous with the European S. scolytus (Fab.). The latter has been intercepted at quarantine stations along the Atlantic seaboard but so far as known is not established in the United States although two other European species, S. multistriatus and S. rugulosus, are well established in numerous localities.

Disregarding S. scolytus there are 20 native, and 2 introduced species in our fauna, more than half of which have been taken in the Northwest.

The smaller, elm bark beetle, S. multistriatus, a serious enemy of elms, is the principal vector of the Dutch elm disease and has recently (1954) been reported from Boise, Idaho. Another introduced species, the fruit-tree bark beetle, S. rugulosus, has been present in the United States for many years and is now found in almost every section of the country, including the Northwest.

Among species attacking coniferous trees, two found in the Northwest are of considerable economic importance. The one spined scolytus, S. unispinosus, attacks young Douglas-fir and tops of older trees, reducing their vitality. In the case of the older trees, this invites attack by other scolytids and often results in the death of the tree. The white fir engraver beetle, S. ventralis, is a primary enemy of various species of Abies and is responsible for the death of large quantities of Abies concolor and A. grandis in mountain areas of the western United States. This loss, according to Struble (1937), amounts to as much as 25% of some California stands.

Our species of Scolytus, 13 in number, all attack coniferous trees with the exception of the introduced elm bark beetle and the fruit-tree bark beetle. A single species, S. monticolae, has been collected from pine; S. laricis breeds in Larix lyallii and L. occidentalis; two species are reported from Picea engelmannii and three species attack mountain hemlock (Tsuga mertensiana), with 2 of these 3 also attacking western hemlock (T. heterophylla). Five species breed in Abies and eight species have been taken from Douglas-fir, Pseudotsuga menziesii.

The Genus

The body is stout, color will range from brown to black with a reddish tinge on the elytra of some species, usually glossy, pubescence very sparse.
THE SCOLYTOIDEA OF THE NORTHWEST

Head visible from above, flattened in front and quite hairy in the male, more convex and less pubescent in female. Antennae with a seven segmented funicle and an ovate club with one distinct, and two indistinct, sutures. Anterior tibiae with nearly parallel sides which are devoid of teeth; the outer distal angle developed into a prominent curved process. The pronotum is large, usually smooth and shining but with very fine punctures and constricted anteriorly.

The elytra are shining and although slightly depressed near the apex they are not declivitous as is so common in many genera of Scolytidae.

The venter of the abdomen is concave or ascends abruptly towards the posterior. This unique character will distinguish the members of this genus from all others in our territory. The second, third, or fourth sternite often bears a spine or tubercle and may or may not have elevated margins.

**The Species**

Many of the species are quite difficult to key out, particularly the females. When collecting the insects, careful attention should be given not only to locality and host tree, but also to the part of the tree attacked and to the type of mine, as these are often valuable in identification.

**Key to Species of Scolytus**

*in the Northwest*

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Abdominal sternites unarmed in both sexes, the second sternite not concave</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>One or more abdominal sternites carinate, tuberculuate, or with one or more teeth or spines at least in the males (sometimes reduced or wanting in <em>subscaber, praeceps</em> and <em>oregoni</em>); second sternite either concave or convex</td>
<td>7</td>
</tr>
<tr>
<td>2.</td>
<td>Elytra clothed with hairs over entire surface, striae and interspaces about equally impressed; epistomal process reduced; sutures between first and second sternites not elevated to form a marginal line. Small species (2.5 mm. long) in broad-leaf trees</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Elytra with disk glabrous, striae more deeply impressed than interspaces; in coniferous trees</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>Elytral striae usually feebly impressed, punctures small, interspaces not at all or feebly impressed; second sternite shining, punctures fine but deep. Small, length 2.2 to 2.8 mm.</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Elytral striae usually rather strongly impressed, punctures coarser, interspaces usually distinctly impressed; second sternite opaque or subopaque, finely but not so deeply punctured. Larger, length 2.8 to 3.4 mm.</td>
<td>6</td>
</tr>
<tr>
<td>4.</td>
<td>Second sternite, in the male at least, deeply concave, with anterior margin strongly extended and typically carinate in median line; female with second sternite either similar or concave with a more weakly elevated anterior margin and carina reduced or lacking</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Second sternite in both sexes vertical or oblique, not concave, armed with a tubercle, spine, or median carina, anterior margin moderate or weak, more extended</td>
<td>7</td>
</tr>
<tr>
<td>5.</td>
<td>Venter of abdomen subopaque in both sexes; second sternite in male very finely, sparsely, obsoletely punctured, in the female convex and moderately punctured; elytra of female scabrous at base, subscabrous to about the middle. Length 3 to 4.5 mm.</td>
<td>1</td>
</tr>
</tbody>
</table>

*Modified in part after Blackman.*
Venter of the abdomen shining, second sternite with carina absent in female and greatly reduced or even obsolete in male, punctures numerous in both sexes; elytra scabrous only at the base in females; second sternite narrowly rounded in front, anterior margin thick, distinctly elevated in both sexes; fifth sternite in male shorter than 3 and 4 combined. Length 3.2 mm. OREGONI Blkm.

6. Second sternite opaque, finely and more closely punctured, the carina usually well developed in male, usually absent in female. Length 3 mm. or more PRAXEPS Lec.

Second sternite subopaque or moderately shining, not closely punctured, carina well developed in both sexes, strongly elevated anteriorly in male to form a spinelike process. Length 2 to 2.5 mm. ABETIS Blkm.

7. Second sternite with carina or base of tubercle or spine reaching posterior margin
Second sternite with base of tubercle or spine not reaching the posterior margin 8

8. Larger species more than 3.6 mm. long; second segment with a small median tooth (often obsolete in the female), segment five concave with strong posterior marginal ridge.

Second sternite subopaque or moderately shining, not closely punctured, carina well developed in both sexes, strongly elevated anteriorly in male to form a spinelike process. Length 2 to 2.5 mm. ABETIS Blkm.

9. Frons of the male more vertical; pronotum finely and sparsely punctured; elytral striae more strongly impressed; second sternite opaque, very finely and sparsely punctured; fifth sternite nearly as long as the third and fourth combined, its posterior outline arcuate.

Frons of the male more sloping; pronotum less finely but more closely punctured; elytral striae more weakly impressed; second sternite shining or subopaque, punctures stronger; fifth sternite but little longer than the fourth, posterior outline arcuate or subangulate.

10. Frons not concave in either sex, elytral interspaces feebly impressed. Frons of male finely aciculate-pectinate with long fine hairs; striae moderately impressed, second sternite subopaque, base of spine reaching the center of segment, fifth sternite with its posterior margin nearly evenly arcuate. Length average 2.4 mm.

Frons of the male feebly concave, elytral interspaces not impressed; coarsely aciculate-pectinate with coarse hairs; second sternite shining, with a stout blunt spine, its base extending from the posterior margin to well beyond center of segment, fifth sternite slightly longer than the fourth, its posterior outline subangulate.

11. Elytra subtruncate behind, striae strongly punctured, moderately but variably impressed, interspaces not impressed; pronotum distinctly wider than long, strongly constricted near anterior margin; venter of abdomen not closely punctured; second sternite with a spine or tubercle arising from center in both sexes; fifth sternite in male shorter than third and fourth combined.

Elytra separately rounded behind, striae and interspaces nearly equally impressed; pronotum scarcely wider than long, moderately constricted near anterior margin; venter of abdomen finely and densely punctured, second sternite with a spine arising from anterior third in both sexes; fifth sternite in both sexes longer than third and fourth combined. In broadleaf trees, usually elms.

Scolytus rugulosus Ratzeburg 37:187 The Fruit-tree Bark Beetle.

A small species 1.8 to 2.4 mm., nearly black, often with a reddish tinge, appendages slightly lighter in color. Easily identified since it is the only species in our territory which uses fruit trees as hosts.
Type locality: Europe.
Distribution: Found in all fruit growing regions of the United States.
Hosts: Various species of *Prunus*, *Pyrus*, and *Crataegus*. Occasionally in other plant species, specimens were taken recently tunneling in *Sorbus sitchensis* at Salem, Oregon.

*S. rugulosus* was introduced into the United States some time prior to 1878, since LeConte reported it from New York at that time.

The typical gallery (fig. 16) lies in the cambium, engraving the sapwood. The tunnel extends up from the entrance tunnel ½ to 2 inches and is nearly straight. Eggs are deposited singly in niches which are very close together on both sides. Larval tunnels start at more or less right angles to the egg tunnel and then turn up or down, running with the grain of the wood. They will vary from 1 to 4 inches in length.

Fig. 16. Typical gallery of
*Scolytus rugulosus*

*Scolytus tsugae* (Swaine) 17:32

Length 2.8 to 3.4 mm. Second sternite vertical with moderately elevated margin, third and fourth short, fifth sternite shorter than 3 and 4 combined, deeply concave with sharply elevated posterior margin.
Type locality: Near Vernon, British Columbia.
Oregon: A large series in the Forest Insect Laboratory at Portland was taken at Crater Lake.
Hosts: *Tsuga mertensiana*, *T. heterophylla*, *Pseudotsuga menziesii*, and *Abies grandis*.

Fig. 17. Gallery of *Scolytus tsugae* (U.S. Forest Service Photograph)
Scolytus monticolae (Swain) 17:32

The galleries of this species are typically biramous, two laterals extending horizontally from a central turning niche and long larval tunnels running with the grain of the wood.

Bedard (38:193) reports this species killing small Douglas-fir trees in Idaho. Type locality: Arrowhead and Creighton, British Columbia.


Oregon distribution: Corvallis, grand fir (WJC), Cascade National Forest, A. procera (WJC), Tollgate (Underhill), Weston (Underhill), Crater Lake (Buckhorn) in T. mertensiana.

Hosts: Pinus monticola (Type), Pseudotsuga menziesii, Abies grandis, and Tsuga mertensiana. This is the only species of the genus reported from any species of Pinus. A small series collected from Abies amabilis near Detroit, Oregon was in the material before Dr. Swaine at the time he described the species.

Note: S. monticolae and S. tsugae are scarcely distinguishable and may be synonymous (See Blackman, 1934, page 16).

Scolytus subscaber (LeConte) 76:371

Length 3.5 to 4 mm., very similar to S. ventralis but easily distinguished by the gallery (fig. 18).

Type locality: Vancouver Island, British Columbia.


Oregon distribution: Blue Mountains, Kiger Island (Benton County) and Corvallis (WJC). Also Wallowa Lake, and McMinnville.

Hosts: Abies grandis, A. concolor, A. magnifica, and probably other Abies, Pseudotsuga menziesii and Larix occidentalis.

Work: The galleries are unlike those of any other species of the genus. The primary gallery resembles a rounded capital “E” and is excavated deep in the sapwood. Eggs (12 to 30) are deposited entirely around the outside and the larval mines run in any direction in the bark, often not showing on the sapwood until the larvae are nearly full grown. Larval mines average about two inches in length.
Struble (37:11) says of this species: “S. subscaber prefers gnarly, or mistletoe-infected branches in which to establish broods, and frequently attacks the main trunk of suppressed trees under 4 inches in diameter. Eggs are packed closely in niches made in the inner bark along the outer rim of an egg gallery cut in an anchor-shaped pattern, which grooves the sapwood. The egg gallery is short; the space occupied is seldom more than 14 mm. across. Larvae feed individually in mines radiating from the egg gallery. At first the inner bark only is mined out. Later on, as the larvae approach maturity, they mine along the surface of the sapwood. Attacks are made during July and August. A fungus-stain organism found associated with this species is similar to the one found with S. praeceps.”

*Scolytus oregoni* Blackman 34:18

Length 3.2 mm. Second sternite vertical, narrowly rounded in front and separated from the first by a thick elevated margin, fifth considerably shorter than third and fourth combined, concave with sharply elevated posterior margin.

Type locality: Ashland, Oregon (Glendenning).


Hosts: *Pseudotsuga menziesii* and *Abies concolor*.

Work not seen.

*Scolytus praeceps* (LeConte) 76:371

Length about 3 mm. (fig. 19). Second sternite nearly perpendicular with an acute margin separating it from the first segment, posterior border with a feeble tooth. Fifth segment longer than third and fourth combined, concave with sharply elevated posterior margin.

Type locality: California.

Distribution: Texas, Arizona, New Mexico, California, Oregon, and Washington. Essig gives Utah and Idaho.

Oregon distribution: Corvallis (WJC), several specimens labeled Oregon, also Bly, Crater Lake, and Beatty. Specimens in the California Academy of Science are labeled Easton, Washington.

Hosts: *Abies grandis*, *A. concolor*, probably other *Abies*. Corvallis specimens from *Pseudotsuga menziesii* (WJC).

Diamond Lake, Oregon *Tsuga mertensiana* (CAS).

Work: This species confines its attack to those portions of the tree having thin bark. It is often found in the same trees as *S. ventralis* but the mines will occur under the thin bark near the top of the trees or in the smaller branches (less than four inches in diameter). The mines engrave the wood and the bark, and consist of two transverse tunnels from a central entrance chamber. These laterals are seldom more than an inch long. Except for being shorter
and smaller in diameter, the mines resemble those of *S. ventralis*. *Praecept* occasionally attacks and kills young trees, especially those which are suppressed or growing under other unfavorable conditions.

**Scolytus abietis** Blackman 34:21

Length 2 to 2.5 mm. Second sternite with a strongly elevated carina extending from the posterior margin to well beyond the center, where it ends in a blunt spine, fifth sternite barely as long as third and fourth combined. 
Type locality: Sand Point, Idaho.
Distribution: Washington, Oregon, and Idaho.
Oregon localities: Tollgate, Weston (Underhill); and Corvallis (WJC);
Hood River in *Abies amabilis* (Blackman); Crater Lake in *Tsuga mertensiana* (Blackman).
Idaho: A large series from *A. grandis* Coeur d' Alene, Idaho (Barr).
Hosts: *Abies grandis*, *A. amabilis*, and *Tsuga mertensiana*.

This species apparently confines its attack to the small branches. One branch \(\frac{1}{4}\) inch in diameter showed 6 primary tunnels within a length of 8 inches. The egg galleries tend to run across the grain of the wood although some are at an angle of 45°. They are definitely biramous with arms of approximately equal length where there is no interference. The turning niche is about \(\frac{1}{4}\) inch (plus or minus). The total length of the egg tunnel is typically about 1 inch (maximum 1\(\frac{1}{4}\)), minimum \(\frac{1}{3}\)). Egg niches are deep, very evident, and closely spaced; average number of eggs is 47 with a minimum of 30 and a maximum of 72 in the complete gallery. Larval mines are about half in the wood from the very start and when unimpaired average about 2 inches in length. The pupal cells are from three-fourths to entirely in the wood.

**Scolytus ventralis** (LeConte) 68:167

This is a large species, length 3.75 mm. Second sternite with a strongly elevated, nearly vertical, median tubercle.
Type locality: California.
Oregon Distribution: Abundant throughout the Cascade range; common in the Blue Mountains and Western Oregon.
Hosts: All species of *Abies* in Oregon, more rarely in *Pseudotsuga menziesii*, *Tsuga mertensiana*, and Blackman records one lot from *Picea engelmannii*. Specimens in the collection of the Oregon State Forestry Department are labeled Western hemlock.

Note: This is one of the largest western species, has the widest distribution and is probably the most destructive species of the genus in the West. It is a primary enemy of *Abies* and is responsible for most of the dead true firs within its range. Struble (1937) states that: "A conservative estimate, based on surveys and observations (between 1924 and 1936), places the destruction of merchantable fir in California alone at about 15 percent of the stand and damage at an additional 25 percent."
Galleries (fig. 20) lie about half in the wood and half in the bark, run-
ning horizontally with two arms extending from the entrance gallery. The total length of the egg gallery varies from 3.5 to 12 inches. Egg numbers vary with the length of the gallery from 80 to as many at 300, the egg niches are prominent and fairly closely spaced. Unless crowded, larval tunnels run in a nearly vertical straight line, both up and down the part attacked. Entrance gallery and nuptial chambers usually lie below the general line of the egg gallery. The egg niches are quite distinct and closed off from the egg tunnel by well packed plugs of frass. Attacks are usually on the main trunk of the trees and may be found from a few feet above the base, up to the top in smaller trees; and in the upper portions, especially the tops of older, more mature, larger firs.

*Scolytus unispinosus* LeConte 76:372 One Spined Scolytus.

A small species (length 2.3 to 2.7 mm.). The second abdominal sternite quite perpendicular, faintly convex, with a stout, obtuse spine, the base of which extends from the posterior margin of the segment to the middle; fifth sternite concave, shorter than three and four combined, the arcuate, posterior margins strongly elevated (fig. 21).

Type locality: Oregon (exact locality not given).

Distribution: Found throughout the Pacific Coast and Rocky Mountain regions.

Hosts: Douglas-fir (*Pseudotsuga menziesii*).

This species has been reported from *Larix occidentalis*, *Tsuga heterophylla*, and *Picea engelmannii*; however these records may apply to other species of this genus which had not been described as distinct at the time the above hosts were cited.

Fig. 20. Gallery of *Scolytus centralis*

Fig. 21. Dorsal and lateral view of *Scolytus unispinosus* (By Hayes)
S. unispinosus is a very common species in the western states where it attacks tops, limbs, and slash from Douglas-fir cuttings. Not infrequently it is found killing young trees (2 to 6 inches DBH.).

Egg galleries (fig. 22) are from 1 to 3 inches in length, always with the grain of the wood and almost invariably with a short spur at a 45° angle. This spur is at the base of the entrance tunnel and is from 1 to 4 mm. in length. It undoubtedly serves as a turning niche and as a shelter for the male beetle. The primary tunnel is in the cambium engraving both bark and wood. Egg niches are very close together in the bark. From 40 to 100 eggs are deposited, averaging around 75. The egg gallery is kept clear with the male’s assistance. It is also his duty to guard the entrance hole to keep out intruders. Larval mines mostly start out at right angles to the egg gallery and are frequently considerably longer than the latter, being 2 to 3½ inches long and engraving the wood quite deeply. The pupal cells are about half in the wood and are approximately twice the length of the beetle itself.

Seasonal history varies, but is generally observed to take the following pattern in western Oregon: adults appear in April; males preceding the females by a few days. Almost immediately they seek suitable material and begin the attack. Pairs are found associated in this work. Eggs hatch in May and the adults from this generation will appear and re-attack in July (at low altitudes), there being two generations under the most favorable conditions. At higher elevations there is apparently a single generation.

Scolytus sobrinus Blackman 34:23

This small species (length 2.74 mm.) is closely related to S. unispinosus but the nearly vertical second abdominal sternite is not strongly margined in front, punctures are fine and few, with a conspicuous stout spine compressed at the base and extending from the posterior margin to the center of the sternite, fifth sternite not as long as third and fourth combined and with a strongly elevated, subarculate, posterior margin.

The type material came from Washington (Kent, type locality), southern Oregon (Ashland and Little Applegate). Specimens were also taken by Hopkins at Jackson, Wyoming.

The only known host is Douglas-fir (Pseudotsuga menziesii).

It is very probable that many representatives of this, and other new species described by Blackman (1934), are in collections under the names unispinosus, tsugae, etc.
Scolytus laricis Blackman 34:24-25
Similar to the last. Smaller, 2.0 to 2.37 mm. long. (See key to species.)
Type locality: Near Moscow, Idaho.
Distribution: Washington, Oregon, and Idaho.
Oregon: John Day.
Washington: North Port, Bumping Lake, and Disantee.
Idaho: Moscow and Coeur d'Alene.
Host: Larix occidentalis and L. lyallii.

Scolytus piceae (Swaine) 10:34
A small species (2.3 to 3.2 mm. in length) with a prominent spine on the second abdominal sternite. This is the only species found in the East which works in coniferous trees. It is closely related to S. unispinosus but can be distinguished since the ventral spine rises from the middle of the nearly perpendicular face of the second sternite, and the spine's base does not extend to the caudal margin.
Type locality: Hudson, Quebec.
Distribution: Maine to New York, west to the Lake States, Manitoba, and Alberta. Also found in North Dakota, Montana, Colorado, Wyoming, Oregon, Washington, and Alaska. Oregon specimens taken in the Whitman National Forest and the Blue Mountains; others seen from Duncan, British Columbia.
THE SCOLYTOIDEA OF THE NORTHWEST

Fig. 24. Gallery of Scolytus piceae

Hosts: Picea canadensis, P. rubens, and P. engelmannii; Larix laricina, and Abies balsamea.
The species attacks largely dead and dying limbs.
The mines (fig. 24.) consist of two egg galleries, one running up and the other down from a central entrance tunnel; they score the wood deeply. From 10 to 30 eggs are deposited in deep niches along the sides. Larval mines start at right angles but soon turn and follow the grain, engraving the wood quite deeply.

Scolytus multistriatus Marsham 1802: 54
The smaller European elm bark beetle is from 2.3 to 3 mm. in length with a long spine rising from the anterior third of the second abdominal sternite.

Described by Marsham in 1802 it has long been known in Europe as an enemy of elms. It was first found in the United States in Massachusetts in 1909 by Chapman (1910).
Type locality: Europe.
Distribution: Many localities in the eastern United States and the species has recently been reported from Boise, Idaho, by F. W. Barr.

Hosts: Various species of elm, Ulmus.
Habits: This insect attacks unhealthy and weakened trees, seldom injuring healthy, vigorous ones. Prior to the introduction of the Dutch elm disease, it was of little importance. As the principal vector of the spores of this disease in the United States, its importance has increased materially.
Life history: Adults appear in May and feed on the host trees in a manner very similar to S. quadrispinosus. After feeding for 7 to 10 days, the beetles seek a weakened tree, or weakened branch of a healthy tree. Here they ex-
cavate their brood gallery and incidentally inoculate the new host with spores of *Ceratocystis ulmi*.

The gallery runs with the grain of the wood, engraving both bark and wood for a distance of 1 to 2 inches. Eggs are deposited in niches along the sides, the larvae working at right angles at first but gradually turning to run with the grain of the wood. Larval mines are usually longer than the egg tunnel and in extreme cases reach a length of 8 inches. Pupation takes place very largely in the bark. Adults emerge through individually excavated emergence holes. There are two generations per year and winter is passed in the larval stage.

### Subfamily HYLESININAE

This is a large subfamily containing some 23 genera and more than 170 species in North America. It is represented in the Northwest by 17 genera, including the genus *Dendroctonus*, various species of which have killed vast quantities of fine merchantable timber in the West. Several other genera are represented by one or more species which are primary enemies of valuable commercial trees.

### Key to Genera of Hylesininae in the Northwest

1. Eyes normal and entire .......................... 2
   Eyes divided, antennal club unsegmented
   ............................................. POLYGRAPHUS Eich.

2. Antennal funicle of 2 or 3 segments; very small species ........................................ 3
   Antennal funicle of more than 3 segments; species of moderately large size .......................... 4

3. Antennal funicle of 2 segments; club with sutures only at the extreme apex ........................ CRYPTURGUS Er.
   Antennal funicle of 3 segments; club segmented ............................................. DOLURGUS Eich.
4. Third foretarsal segment cylindrical not widened ........................................... 5
Third foretarsal segment distinctly widened and emarginate or bilobed .................. 7

5. Eyes deeply narrowly emarginate; antennal scape slightly longer than the funicle ........
........................................................................CARPHOBORUS Eich.
Eyes feebly sinuate in front, hardly emarginate; antennal scape shorter than the funicle ................................................................. 6

6. Anterior coxae in contact with the head beneath, sternum before them obsolete; tibia margined with short, stout teeth; antennal club elongate, stout, 4 segments...RENOCIS Csy.

7. Antennal funicle of less than 7 segments..... 9
Antennal funicle of 7 segments .................. 11
9. Forecoxae almost contiguous; metepimeron visible in part; epistomal process basal and well developed; antennal funicle of 5 segments, club flattened, thickened at the base, as wide or wider than long, mostly large species ............................................ DENDROCTONUS Fr.

Forecoxae moderately or narrowly separated; metepimeron covered by the elytra; antennal club much longer than wide; front without basal epistomal process; smaller species ......................................... 10

10. Antennal funicle with the outer segments distinctly broader; club elongate, pubescent; eyes deeply emarginate; alternate interspaces of the declivity usually serrate or granulate, more pronounced in the males, mostly in Cupressinae trees ........................................... PHLOEOSINUS Chap.

Antennal funicle with outer segments scarcely widened; club densely clothed with coarse, erect hairs on the upper surface; declivity without serrulations or granules. Not in cedar trees .................. XYLECHINUS Chap.

11. Forecoxae rather widely separated .......... 12

Forecoxae somewhat narrowly separated ... 14

12. Antennal club very strongly compressed; clothed above with scales. Restricted to ash as a host. .............................................. LEPERISINUS Reit.

Antennal club hardly flattened, subconical, with the first segment almost as long as the second and third combined; epistoma scaly ...................................................... SCERUS Lec.

13. Antennal club with the first suture alone strongly sclerotized, distinct; first and second segments each longer than the third and fourth united; ligula widened distally and truncate at the tip; the distance from the front of the eyes to the base of the mandibles is much greater than the width of the eyes ........................................... HYLASTINUS Bedel.

Antennal club with the first 2 sutures strongly sclerotized and distinct, the 2 apical segments together longer than the second, tip pointed; funicle more strongly widened distally; the distance between the eyes and the base of the mandibles hardly greater than the width of the eyes, which are narrow and elongate, passing the base of the mandibles on the ventral side of the head. Host alder only ............................................ ALNIPHAGUS Sw.
14. Elytra with the bases very strongly arcuate, slightly elevated and finely serrulate; first, second, and fifth ventral segments subequal in length; ligula wide, from a convex chitinized base, narrowed distally; antennal hairs stout and plumose; metasternum somewhat inflated. \textit{Pseudohylesinus} Sw.

Elytral bases at most but moderately arcuate and not regularly serrulate; first and fifth ventral segments subequal in length and longer than the others; ligula slender, from a box-like, strongly sclerotized basal inflation .................................................. 15

15. Third tarsal segment much widened and bilobed; mesosternum protuberant in front; bases of elytra usually rounded ............

\textit{Hylurgops} Lec. Third tarsal segment but little widened and emarginate; mesosternum not protuberant; base of elytra nearly straight ..\textit{Hylastes} Er.

3 Genus \textit{Crypturgus} Erichson 36:60

Members of this genus are among the smallest of our bark beetles. They are distinguished by their small size and cylindrical form, and differ from all other genera by having the antennal funicle with only two segments (fig. 14). The club is segmented only at the tip which distinguishes the species from \textit{Dolurgus}.

\textit{Crypturgus borealis} Swaine 17:7

\textit{C. corrugatus} Swaine 17:8 is a synonym.

Our single species may be separated by the characters as given above. The length is about 1.2 mm.

Type locality: Winnipeg, Manitoba.

Distribution: Manitoba to the Pacific coast, south to California, and into Colorado. In Oregon we have specimens from Newport (Sitka spruce), and Grant County near Granite in \textit{Abies lasiocarpa}; Joseph, Ashland, Rainier, and Medford (no host). Specimens have been seen from Winthrop taken in Douglas-fir, and Metaline Falls in Engelmann spruce, both localities in Washington.


In Sitka spruce these beetles enter the tunnels of \textit{Dendroctonus obsesus} or \textit{Ips concinnus}, possibly other species.

They differ in habits from all other scolytids (except \textit{Dolurgus}) in that they do not excavate their mines from the outside of the host. They enter tunnels of larger species and excavate their own egg tunnels from the latter.
Their tunnels will extend from \( \frac{1}{2} \) to 1\( \frac{1}{2} \) inches, and may be straight or winding. The larvae work in the bark but the character of the larval tunnels has not been ascertained by the writer.

4 Genus DOLURGUS Eichhoff 68:147

Small cylindrical species 1.6 to 2 mm. in length, front densely punctate; antennal funicle of three segments, scape almost as long as the ovate club, compressed, and composed of four segments.

The genus is represented by a single species in North America.

* Dolurgus pumilus* (Mannerheim) 43:247

In addition to the characters given above, the small size, pronotum strongly narrowed at anterior half, striae, and very pronounced punctures of the elytra (fig. 26) will identify this species.

Type locality: Alaska.

Distribution: Alaska to Southern Oregon and into California.

Oregon distribution: Generally distributed over the state; Newport, Corvallis, Blue Mountains, Sutherlin, Marshfield, Canon Beach, Florence, Randle, Rainier, and Ashland.

Hosts: Engelmann spruce *Picea engelmannii*; Sitka spruce *P. sitchensis* (WJC); Douglas-fir *Pseudotsuga menziesii* (WJC); White pine *Pinus monticola* (Keen 52:166); Bishop pine *P. muricata* (Keen 29:118); *Abies grandis* (WJC).

*Pumilus* is similar in habits to *Crypturgus*, using mines of *Ips*, *Dendroctonus*, *Pseudohylesinus*, and probably other large species to gain entrance for starting their egg tunnels. The tunnels are minute and difficult to follow. They seem to have no set design but progress in any direction in the bark, not contacting the wood.

Adults were collected January 1, 1945 hibernating under moss and lichens, fifty feet up a lodgepole pine near Waldport, Oregon.

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* New host, a considerable series bred from *Abies grandis* associated with *Pseudohylesinus grandis* at Corvallis, 1953.
5 Genus POLYGRAPHUS Erichson 36:57

Species of this genus are readily separated from all others of similar appearance because the eyes are completely divided* giving them the common name of "four eyed bark beetles." In addition to divided eyes, the antennal scape is about as long as the club; the club is solid without segments (fig. 14) and front tibiae are denticulate on the outer edge. There has been much synonymy in the genus, see Chamberlin (39:121). The genus is represented in the Northwest by two species.

* A character found in only one other genus of bark beetles (Carphoborus) and in species of Trypodendron which are ambrosia beetles.

\[ Polygraphus rufipennis \] (Kirby) 37:193

A medium sized beetle (fig. 27) length 2.5 to 3.5 mm., nearly black, clothed with medium long hairs, antennal funicle of 5 or 6 segments (variable within a single brood).

Type locality: As was often the case, Kirby does not give exact type locality stating only, "taken at Latitude 65 degrees in northern Rocky Mountains."

Distribution: A very widely distributed species found from Alaska to Newfoundland and south through most coniferous forest areas of northern United States.

Oregon distribution: Rare in Oregon. Specimens have been seen from Klamath Falls, Corvallis, and Tollgate, Oregon. Washington localities are Winthrop, Mount Rainier, and Parkway. The species is more abundant in British Columbia and Alaska.

Hosts: Probably most species Picea; also reported from Larix, and Hopkins reports finding it rarely in Abies balsamea, while Swaine (29:146) reports it "less common in pine." Keen (52:166) reports lodgepole pine, limber pine, larch, and Douglas-fir as hosts. Specimens in the Hopping collection are labeled Abies lasiocarpa.

Habits and work: Because of the painstaking work of Swaine (29:145) and his associates in Canada the habits of this bark beetle have been reported in considerable detail.
In New Brunswick, winter is passed in all stages except the egg, and usually in stumps, broken trees, limbs, tops, logs, etc. of trees cut the preceding summer. Adults emerge in May and June and attack material similar to that mentioned above. They also readily attack trees defoliated by the spruce budworm or those suffering from the attack of *Dendroctonus picea-perda*. A female makes an entrance tunnel to the inner bark where a nuptial chamber is excavated. The male joins his mate at this time and assists by working the borings out through the entrance tunnel while the female excavates the egg tunnel proper. This original pair is joined by 2 or sometimes 3 other females, each of these excavating her own egg gallery radiating out from the nuptial chamber through the inner bark (fig. 28).

Eggs are placed singly, in deep niches on both sides of the tunnel. They are covered over with tightly packed frass and borings. Egg galleries average 1 to 2 inches in length. Incubation lasts five days and the larvae work in the inner bark. Larval tunnels are quite regular unless crowded, then they criss-cross until the design is lost. In about 25 days larvae are full grown and excavating cells in which to transform to pupae and adults. The pupal stage lasts 7 to 10 days, making a total elapsed time from egg to adult of 37 to 40 days. Newly formed adults do not emerge at once but hibernate in their cells until the following May or June.

Having completed one egg gallery and deposited her complement of eggs the female may excavate a new egg tunnel and deposit more eggs. Simpson (29:146) found that not only 2, but 3 and even 4 broods were the progeny of a single female and that 2 seasons might be required for the work. Heretofore these were considered generations rather than broods.

*Polygraphus convexifrons* Wood 51:32

Female—Black, covered with moderately dense, small, semierect, white scales. Length 2.3 mm.; 2.6 times as long, as wide. Closely allied to *P. hop-pingi* Swaine.

Front of head distinctly convex above the epistoma; finely but densely punctured, covered with short, fine, inconspicuous, yellow hairs. Eye divided with 1 to 3 facets scattered along the posterior margin between the 2 halves.
Antennal funicle of five segments; club unsegmented with the apex very strongly acuminate as in *P. hoppingi*.

Pronotum 1.25 times as wide as it is long, finely punctured, covered with erect scales; sides arcuately narrowed from the base to a moderate constriction just behind the anterior margin.

Elytra with fine, confused, somewhat granulate punctures; covered with semierect, white, scale-like hair. Declivity slightly flattened, the suture distinctly elevated.

A slender species, very similar to *P. hoppingi*, but readily separated by the distinctly convex frons and much shorter frontal pubescence of the female. The frontal elevation of the male slightly higher than in *P. hoppingi*. Type locality: Logan Dry Canyon, Utah. Distribution: Utah and Idaho. Host: *Picea engelmannii*.

6 Genus RENOCIS Casey 86:257

Small stout species; frons of male concave with long coarse setae. Funicle of antennae, 5 segments; club elongate, 4 segments. Pronotum wider than long, narrowed in front, clothed with scales and with 2 or 3 small groups of asperities on the disk of each side. Base of elytra strongly elevated, striae punctate, interspaces with recumbent scales. Prosternum scarcely visible. Represented in the Northwest by a single species.

*Renocis heterodoxus* Casey 86:258 (fig. 29)

*Pseudocryphalus brittaini* Swaine (17:20) is a synonym (vide Wood).

*Pseudocryphalus criddlei* Sw. (17:21) is a synonym (vide Wood).

Small, 1.5 to 2.5 mm. long, stout, grayish black, twice as long as wide, densely clothed with scales; frons with epistomal margin fringed with coarse, nearly white setae directed downward and with a short, sharp tooth at the middle. Basal margins of elytra strongly elevated. Ventral surface well covered with hair-like scales.


Recorded hosts: *Amelanchier florida*, *A. alnifolia* commonly in Washington, Idaho, and
flora, Cercocarpus betuloides, C. alnifolius, C. ledifolius, and Prunus virginiana melanocarpa. Specimens in the collection of the Forest Insect Laboratory at Portland are labeled Prunus sp. taken by Furniss. R. brittaini was collected from apple and R. criddlei was taken from Prunus virginiana (Swaine).

Ordinarily considered as a secondary pest of chaparral areas. In 1951-1952 the beetle appeared in large numbers and killed the mountain mahogany over many square miles in southeastern Oregon. This caused considerable concern to both cattlemen and the game commission since the material destroyed was the principal browse plant for deer. (Chamberlin 1955: 118 to 120).

The species are monogamous and enter the host plant in June.* The pair excavates an unusual chamber which is roughly oval 4 x 6 mm., engraving the wood deeply; extending out from this cave-like chamber there are 3 to 6 (typically 5), finger-like short galleries (fig. 30) from 1 to 3 mm. long. At the end of each, 6 to 12 eggs are deposited; from there, individual larval galleries extend about ½ inch; they engrave the wood rather deeply. The oval pupal cells are about three-quarters in the wood and a quarter in the bark. Adults exit through the thin bark, leaving a circular exit hole about .75 mm. in diameter.

The adults apparently over-winter in the galleries and eggs are deposited in March. Well-grown larvae were found April 8 and pupae were observed May 15. Newly formed, partially colored adults were present* on June 1. These were fully colored and mature by June 25, and excavated some irregular areas under the bark, possibly for food. They did not emerge until late July, after which they made new entrance tunnels, often in the same section from which they had emerged, and deposited eggs. A year later the beetles were still working in the mahogany limbs. This continued until the bark was almost completely destroyed in 1954, but a few living adults were present in May, 1955.

* May be a second generation.
Actions of these beetles in breeding cages differ from other scolytids under similar conditions. They mate and re-enter the sections of mountain mahogany without coming to the glass vials. During the first two years they were in the cages, almost no adults appeared in the vials. Since March, 1953 a considerable number have been coming to the light. They continue to breed in the very dry and exceedingly hard mahogany limbs and there is scarcely a square millimeter of untouched surface.

7 Genus CARPHOBORUS Eichhoff 64:27,
Bruck (33:103-106), Blackman (22:49), and Wood (54:502-526)

The genus Carphoborus was recently (1954) reviewed by S. W. Wood and of the 17 North American species 4 occur in this area. They breed in shaded out or broken branches still hanging to the tree.

The species are small (length 1.4 to 3 mm.). Color—grayish-yellow to brownish-black; mouth parts with abundant, long, yellow hairs. Eyes deeply emarginate, almost divided; antennal funicle 5-segmented and basal segment greatly enlarged; club flattened, with 3 transverse sutures conspicuously marked by rows of setae (fig. 31), first 2 sutures septate. Pronotum slightly wider than long, rather coarsely punctured and densely clothed with erect scales. Elytral striae slightly impressed, coarsely, closely, rather deeply punctured; interspaces closely punctured. Declivity steep with alternate interspaces elevated and serrate.

Female frons usually flattened, rarely concave or convex; male frons transversely impressed, usually with a pair of subcarinate, basally fused tubercles at the upper margin of the impression.

The species are polygamous and a large, central nuptial chamber is excavated in the cambium region, engraving the wood rather deeply at the base of the entrance tunnel, which is usually on the underside of the limb. One male will have 5 to 8 females associated with him and each of these excavates an egg gallery; the galleries radiate out from the central chamber. They contain closely placed egg niches. Larval tunnels are short and lacking in definite pattern, often doubling back and often crossing. The larval mines are largely in the bark.

Carphoborus is closely related to Polygraphus (Wood 54:505). The species are of little or no economic importance.

* These data are from insects in breeding cages in the laboratory and may not coincide with field data.
Key to Species of CARPHOBORUS in the Northwest

1. Antennal club large, broad, less than 1.2 times as long as wide; female frons impunctate and glabrous on a rather large median area; transverse impression of male frons more conspicuous and extensive, the median elevation rather large and prominent .......................................................... 2

   Antennal club small and narrow, 1.3 or more times as long as wide; female frons punctate or granulate, and pubescent over entire surface; male frons usually less strongly impressed below, the median elevation smaller, often absent .......................................................... 3

2. Sutures of antennal club suboblique, rather strongly arcuate; third and ninth declivital interspaces usually less strongly elevated, serrations smaller and less abundant; in *Pseudotsuga menziesii* ....................... VANDYKEI Bruck

   Sutures of antennal club subtransverse, nearly straight; third and ninth declivital interspaces usually more strongly elevated, serrations larger and more abundant; in *Pinus* spp. ....................... PINICOLENS Wood

3. Female frons flattened, rather coarsely punctured, declivital teeth on third interspaces very coarse, longer than the height of the interspace; declivital interspaces 2, 4, 6, and 8 never serrate. British Columbia to Utah in *Pinus ponderosa* or *P. contorta* ............................... PONDEROSAE Sw.

   Frons of female flattened, rather coarsely punctured, declivital teeth fine, those on the third interspace much shorter than the height of the interspace, even-numbered declivital interspaces serrate. Oregon and Washington in *Picea engelmannii* or *Pinus contorta* ............................... INTERMEDIUS Wood
Carphoborus pinicolens Wood 54:512

Synonyms C. blaisdelli Bruck (vide Wood); C. simplex Bruck not LeConte.

Length, 1.7 to 2.4 mm. Black; antennal club as long as wide; sutures transverse, first straight, others slightly arcuate. Female frons flattened, epistomal region transversely elevated. Male frons transversely impressed (longitudinally concave), coarsely punctured, with a median, bituberculate, transverse elevation.

Type locality: Logan Dry Canyon, Utah.

Distribution: New Mexico to Wyoming and west to Arizona, Nevada, California, and Oregon, including Utah and Colorado. The species probably occurs in Idaho.


Hosts: (As reported by Wood) Pinus flexilis, P. edulis, P. lambertiana, P. leiophylla, P. monophylla, and P. ponderosa.

This species has apparently been confused with other species (especially simplex) and in reality is one of the most common and widespread species of the genus. It probably breeds in most species of pines.

Carphoborus vandykei Bruck 33:103

This species is quite similar to the last but can be distinguished by its smaller size (length, 1.5 to 2.5 mm.), characters given in the key, and by the host.

Type locality: Mount Saint Helens, Marin County, California.

Distribution: California and Oregon to British Columbia.

Oregon distribution: The species must be very rare in Oregon. Doane et al (1936:108) report it from the state without exact locality. Specimens in the Forest Insect Laboratory at Portland from Ashland and Waldo taken from Douglas-fir are probably this species although labeled C. simplex. Our specimens are from Corvallis.

Host: Pseudotsuga menziesii.

Carphoborus intermedius Wood 54:523

Front of the male, convex above but transversely impressed below; clothed with very short, coarse hairs. Elytra sides subparallel on basal two-thirds; basal margins elevated and armed with about ten large, overlapping crenulations; striae slightly impressed, the punctures large, deep and close. Declival interspaces (see key): second very narrow, third wider than first; first, third, fifth, seventh, and ninth finely serrate; fourth and eighth sub-tuberculate behind.

Female similar, except the front is flat and shining, vestiture of frons very long, fine, and less abundant. Length, 1.9 to 2.1 mm.

Type locality: New Castle, Colorado.


Hosts: Picea engelmannii and Pinus contorta.

The Washington specimens came from Metaline Falls and the Oregon specimens were collected at Tollgate.
Carphoborus ponderosae Swaine 24:236
Length 2.5 mm. Front of female closely, deeply punctured, broadly and deeply excavated and densely clothed with yellow hairs on the cephalic half; antennal club with straight sutures. Pronotum longer than wide, median line narrow.
Elytral striae impressed; declivity strongly punctate; first and third interspace strongly carinate and closely armed with elongate teeth, third more strongly elevated and serrate, second obsolete on the declivity; fifth, seventh, and ninth interspaces carinate near the apex.
Male front convex, deeply punctured with a flattened transverse tubercle between the eyes.
Type locality: Midday Valley, Merritt, British Columbia.
Distribution: British Columbia to Utah. We have not seen specimens from this territory, but Wood (54:521) reports a series collected at Fort Rock, Oregon.
Host: Pinus ponderosa and P. contorta.

Fig. 32. Carphoborus ponderosae adult

Fig. 33. Phthorophloeus mississippiensis (After Blackman)

8 Genus PHTHOROPHLOEUS Rey 83:127-28
The eight named species found in North America have been described under six generic names. This (Chamberlin 39:139) has given rise to considerable confusion.
A single species occurs in our territory.

Phthorophlocus puberulus (LeConte) 79:519-520
Length, 2.5 mm. Front of head nearly smooth, shining, broadly concave with two small tubercles on the epistoma. Elytra with shallow striae of quadrate punctures; interspaces elevated about as wide as striae, with hairs arranged in rows.
Type locality: Vele Pass, Colorado.
Distribution: Colorado to Idaho, Oregon, Washington, and British Columbia.
We have seen specimens from Bear Springs and Umatilla County, Oregon; Walla Walla and Kooskassie, Washington; and Creston, British Columbia.
Host: Douglas-fir, Pseudotsuga menziesii, Picea engelmannii, Abies grandis, and Pinus ponderosa.
Habits: Galleries are similar to those of Pseudopityophthorus (fig. 81) and are found in tops and limbs of Douglas-fir.
Species of this genus are readily separated from all other bark beetles occurring in our territory by a single character, i.e. the antennal club is semi-lamellate (fig. 33) composed of three loosely connected segments which are produced on the inside.

9 The Genus DENDROCTONUS Erichson 36:45-65

(Hopkins 1909)

The genus is appropriately named, for Dendroctonus means "killer of trees." It is by far the most destructive group of insects infesting North American coniferous forests. Many species kill healthy trees outright and have been known to cause widespread depredations during periods of severe epidemic. Determination in monetary figures of the damage caused by this genus to our forests is difficult to ascertain, but our best-informed authorities place it at no less than twenty millions of dollars annually in the United States.

At the present time there are 24 known species for the entire world, 23 of which are found only in North America and one, micans, in Europe. Of the 23 North American species, 19 are found in that part of America north of Mexico and the remaining species in Mexico and Central America. No species of Dendroctonus is known to occur south of the equator. Many of the species were originally assigned to other genera, while species, previously described as Dendroctonus, have been removed to different groups.

Genus DENDROCTONUS Erichson 36:45

In this genus the head is broad and prominent, visible from above; the beak very short, with a well developed epistomal process; the antennal funicle (plate I) 5-segmented, with the club broad, thickened basally and flattened distally; the pronotum approximately half as long, and as wide—or nearly so—as the elytra, punctured throughout; anterior coxae approximate; tarsi with the third segment dilated and bilobed; the elytra crenulate at the base, with striae either slightly or distinctly impressed and the strial punctures small to moderately coarse; declivity abrupt.

Adult beetles are stout to slightly elongate, cylindrical, and vary in length from 2.2 mm, to 9.5 mm. In color they range from reddish to dark reddish-brown and black.

The eggs are slightly oblong, rounded at the ends, pearly white and shining. They show no specific differences except in size, which changes with the size of the females.

Larvae (fig. 30a) are stout, cylindrical, footless, yellowish-white in color with darker, shining heads. The body is deeply and closely wrinkled.

Pupae resemble adults in size, but lack the color, being yellowish-white; legs and wing pads are folded under the body exposing the abdominal segments.
GENERAL HABITS

All species of the genus *Dendroctonus* are capable of attacking and killing normal trees whenever present in sufficient numbers to overcome the tree’s resistance and if proper environmental conditions prevail. Some species have the habit of “swarming” and then concentrate upon given groups of trees in sufficient numbers to cause great damage.

Under ordinary conditions, all of the species will attack weakened trees, fresh logs, or stumps, but some show a decided preference for apparently healthy trees, and beetles of this group often choose the largest trees in the stand.

First evidences of attack on living trees will be seen as the presence of boring dust in bark crevices and often on the ground at the tree’s base, and the forming of so-called pitch tubes at the entrance holes. The beetles show remarkable cleverness in avoiding the disastrous effects of becoming caught in the resin flow. The beetles overcome the resin flow by mixing it with boring dust and causing it to flow out the entrance hole. It then hardens into pitch tubes on the outside of the tree. In the cases of *Pseudotsuga* and *Larix* the pitch flow does not harden into pitch tubes but merely flows out of the entrance hole proceeding downward along the bole of the tree.

The general procedure of these bark beetles is as follows: the broods hibernate over the winter as young or mature adults, or larvae (rarely as eggs) in various stages of development. When the tree begins to function in the spring, the old adults continue old galleries or emerge and start new ones; young adults mature and leave the host to begin new egg galleries; old larvae pupate, while young larvae finish their development and then pupate. Any overwintering eggs will hatch, and the larvae begin their development. Thus, all during the spring, summer, and fall months new trees are attacked by the emerging beetles.

The general method of attack is for the female to fly about, choose both mate and host, and begin constructing her egg gallery. Time and place of mating are not certain for many species. In the case of the Douglas-fir beetle mating takes place in the new gallery when the male arrives. If no male comes the female abandons the gallery or deposits unfertilized eggs. In general, the female excavates the entrance tunnel into the bole of the selected tree. Upon reaching the cambium, she excavates an egg gallery, usually longitudinal but sometimes curved, winding, or oblique, scoring both inner bark and wood, the latter often only slightly. Eggs are deposited separately in niches; by groups in egg pockets; in lines in egg grooves; or in a few cases, about the edge of a cave-like tunnel as in *D. valens*. Upon ovipositing an egg, the female covers it with frass and borings mixed with a sticky substance, so that the egg is hidden from the egg gallery.

The male helps the female keep the gallery free from boring dust and resin flow, and guards the entrance against intrusion by parasites or predators. He does guard duty by backing out the entrance tunnel so that his elytral declivity blocks the entrance hole.
The eggs hatch and the young larvae begin their mines at right angles to the egg galleries, boring through the cambium or into the bark. With some species larval mines are wholly within the inner bark, while with others they are exposed in the cambium, scoring both bark and wood but the wood only slightly. Larval mines gradually increase in size as the larvae develop and grow, and are packed with boring dust and frass. In some species the larvae bore out en masse before beginning separate larval mines, while in others the larvae feed gregariously and eat out a large leaflike area in the cambium without forming separate mines at all. Upon maturity the larvae excavate pupal cells, which are usually wholly within the bark, but may be visible in the cambium with some species. In these cells they transform to the pupal stage. After transformation the young beetle bores out through the bark and flies away to mate and infest a new host, although some may overwinter in place as newly formed adults.

Why female beetles choose to attack certain trees and at the same time pass up trees of apparently the same condition, age, and vitality has long been a mystery. The work of Craighead and Miller (1931) states that the initial attraction of beetles to a tree is due to the formation and escape of volatile aldehydes or esters which are a byproduct of a respiratory fermentation resulting from abnormal enzyme activity in subnormal trees. This condition may be caused by drought, injuries of various kinds, or other causes, which interfere with normal tree physiology; and the initial attraction, by only slightly subnormal trees is probably so weak as to be detected only by beetles in the immediate vicinity. However, after a few attacks are made, the yeast introduced by the beetle begins fermentation in the inner bark, and the tree becomes very attractive to subsequent attacks.

LIFE HISTORY

Length of the life cycle depends upon the species, geographical location, and prevailing weather conditions at the time. Most species have only one generation per year, others have one and a partial second, while some of the more southern species, as *D. frontalis*, may produce from 2 to 5 generations in a year. At the other extreme we find *D. johanseni* in northern Canada and *D. rufipennis* in northeastern Ontario requiring two years for their life cycles, as does *D. engelmanni* at high elevations in the Rocky Mountains. Life histories vary considerably in detail and it would require many pages to cover them all.

HOSTS AND GENERAL DISTRIBUTION

All members of the genus *Dendroctonus* are normally confined to four genera of host trees belonging to the family *Pinaceae*. These are *Pinus*, *Picea*, *Larix*, and *Pseudotsuga*. Some species are very limited as to their hosts; for example, *D. jeffreyi*, whose only host is Jeffrey pine and *D. obesus* which is

*Dendroctonus pseudotsugae* is found attacking *Tsuga heterophylla* very rarely. *Abies* has also been reported attacked. It is probable that such trees are more or less accidental hosts.
found only in Sitka spruce. However, some attack several species of trees and even trees belonging to different genera; for example, *D. ponderosae* works in both pine and spruce.

The geographical distribution of the genus can be said to cover practically all coniferous forest areas in North America. Individual distributions range from very widely distributed species (*D. valens*) to those closely confined to specific, relatively small areas, (*D. jeffreyi*). *Dendroctonus valens* is, by far, the most widely distributed species, ranging throughout all coniferous forest regions of North America, with the exception of a part of the southern pine region of the United States. As an example of a species confined to a relatively small area, *D. arizonicus* is restricted to central Arizona.

**KEY TO THE SPECIES**

Because various species or groups of species within the genus *Dendroctonus* resemble one another so closely, characters used to distinguish each species are often seemingly insignificant. However, with many of the species this is the only possibility. Characters which suitably serve to separate different species of other beetle genera are variable, inconsistent, and therefore valueless in *Dendroctonus*.

Characters used in the following keys are generalities. However, in most cases they will suffice to separate the species, especially if host trees, distribution, and mine types are considered in conjunction with taxonomic differences. It is well to bear in mind that quite often variations occur between individuals of the same species, especially in different parts of the beetle's range, and between the two sexes.

Since only species of the Northwest are included, their keying is relatively less complicated.

**Key to Species of DENDROCTONUS of the Northwest**

1. Prothorax somewhat elongate, only slightly narrowed in front. Anterior dorsal half of elytra without long, erect hairs .............................................. 2
   Prothorax stout, usually narrower than the elytra, distinctly narrowed or constricted toward the head. Anterior dorsal half of the elytra bearing long hairs (except in badly rubbed specimens) .............................................. 4

2. Head with distinct frontal groove, species small (3.2 to 5 mm. in length) in *Pinus ponderosa*; long winding egg galleries, larval mines not evident in cambium ............................................................... *BREVICOMIS* LeC.
   Head without frontal groove, species larger (4 to 7 mm. or larger) .............................................. 3

3. Elytral striae distinctly impressed, especially on the dorsal area, with punctures distinct and coarse. Distribution—southern Oregon, south throughout the range of its only host, Jeffrey pine ............................................................... *JEFFREYI* Hopk.
   Elytral striae not distinctly impressed, except toward the suture, and with the punctures small. Distribution—mountains of California northward through mountains of Oregon and Washington, and eastward into Montana and western Wyoming ............................................................... *MONTICOLAE* Hopk.
4. Front usually with posterior impression. Pronotum with large and small punctures intermixed, and with long hairs on the dorsal and lateral areas ........................................ 5
   Front without median or posterior impression. Pronotum somewhat elongate, slightly narrower than elytra, moderately constricted toward the head, with regular punctures (or without coarse and fine punctures intermixed). Head broad, convex. Elytra with few long hairs toward the base. Pronotum with punctures moderately coarse, much smaller and denser toward the base. More distinctly reddish in color and the largest (6.5 to 9.5 mm. long) of all bark beetles. Attacks near the base of all species of *Pinus*, rarely in other species of conifers .................................................. *VALENS* Lec.

5. Elytral declivity with striae not deeply impressed. Pronotum with punctures fairly coarse and distinctly irregular ........................................ 6
   Elytral declivity with striae deeply impressed. Head with front convex, with faint posterior impression. Epistomial process narrow, slight, with sides nearly parallel, the apex scarcely projecting beyond the anterior margin. Pronotum finely, but also irregularly, punctured. The only species* of the genus found in Douglas-fir .................................................. *PSEUDOTSUGAE* Hopk.

   Posterior half of proepisternal area not punctured ........................................ 7

7. In Sitka spruce *Picea sitchensis* only. Along the Pacific coastal areas from Alaska to California .................................................. *OBESUS* Mann.
   In other species of spruce ........................................................................... 8

8. Elytral striae (laterally) more distinctly impressed than in *D. obesus*. Attacks
   *Picea engelmannii* from eastern Washington and Oregon, central Idaho southward to southern New Mexico, and *P. glauca* in the Black Hills of South Dakota. Also found in *Pinus contorta* .................................................. *ENGELMANNI* Hopk.
   Pronotum with punctures more uniform in size, and punctures of the dorsal striae of the elytra finer and less distinct than in any of the other spruce bark beetles. Attacks *Picea glauca* and *P. engelmannii* in Alaska to Oregon (rare in Oregon and Washington) east to Manitoba .................................. *BOREALIS* Hopk.

*Dendroctonus brevicomis* LeConte 76:384 The Western Pine Beetle

Length, 3.2 mm. to 5 mm.—average 4.2 mm.; color dark brown to black; the front elevated on each side of a deep median groove in the male, faintly so in the female; the elytra as wide as the pronotum; the striae faintly impressed, strial punctures very small. The small size; the median groove on the front; and the type of egg galleries, with larval tunnels, not visible on the inner bark will serve to identify this species.

Type locality: Middle California.

Distribution: From British Columbia south through Washington, Oregon, California, and into Idaho, western Montana, and northwestern Wyoming.

Hosts: *Pinus ponderosa* and *P. coulteri*; rarely *P. lambertiana* and *P. contorta*. The latter two species may be regarded as accidental hosts.

General remarks: This species has been the most destructive bark beetle in the Northwest's coniferous forests. For nearly thirty years (1912-1942) there was an almost continuous epidemic in parts of the ponderosa pine areas

* *Dendroctonus valens* is found working at the base of Douglas-fir in some localities but will be readily separated by its large size, red color, and different type of mine.
DENDROCTONUS OF THE NORTHWEST

PLATE III

*Dendroctonus* of the Northwest

*All drawings by Hays to the same scale.*
of Pacific Coast and Rocky Mountain states. The value of timber killed runs into hundreds of millions of dollars.

This beetle is especially destructive because it tends to attack the finest mature trees in the stand. In exceptional cases, when conditions are favorable, as much as 10% of the stand in large areas may be killed during one year.

Habits and work: *D. brevicomis* apparently prefers living trees, but at times attacks logs, windfalls, or broken and injured trees. Attack is usually confined to the main bole; it does not attack tops and is rarely found in stumps.

Egg mines are in the cambium and are long and winding. When the attack is heavy they may cross and recross, forming a veritable network (fig. 34). Galleries are tightly packed with borings. Eggs are deposited in niches at regular intervals and the larvae work entirely in the bark with their mines not evident in the cambium. Pupation occurs in special cells in the outer portion of the inner bark or the inner portion of the outer bark and adults emerge through individual exit holes cut through the bark. The long winding egg galleries and the absence of larval tunnels in the cambium will serve to separate this species from all others found in the same host in this locality.
The winding egg galleries quickly and effectively (with the help of blue-stain fungi) stop the water and food transportation up and down the trunk so that the tree dies within 10 to 14 days. Keen (33:2) estimates that it requires about 24 beetles to a square foot for a successful attack.

This species carries spores of a blue-stain fungus which materially assists in hastening the death of the tree and lowering the lumber value if the logs are milled.

*Dendroctonus monticolae* Hopkins 09:105 The Mountain Pine Beetle

Length, 3.7 mm. to 6.7 mm.; color usually black or dark brown; front convex, faintly impressed behind on the middle line; the pronotum as wide as the elytra, with the sides strongly constricted in front, the punctuation close and small; the elytra with the striae distinctly impressed, more feebly on the sides, strial punctures small, interspaces slightly convex on the disk with moderately close granules of varying size; the declivital striae rather strongly, narrowly impressed, with very small punctures, the second and third strongly sinuate; the pubescence of the elytra short and sparse, with a few longer hairs extending nearly to the base.

Type locality: Kootenai, Idaho.

Distribution: From British Columbia south through Rocky Mountain and Pacific Coast states.

Hosts: All species of *Pinus* found within its range including *P. ponderosa*, *P. contorta*, *P. albicaulis*, *P. monticola*, *P. lambertiana*, and others. It is also reported to attack mountain hemlock (*Tsuga mertensiana*) and Engelmann spruce (*Picea engelmannii*).

General remarks: This species ranks second only to *D. brevicomis* in economic importance in this area, and having a much wider distribution and more host species, in the aggregate it may cause even greater damage and loss.

It caused the death of nearly all the commercial, western white pine in British Columbia and has killed millions of board-feet of the same species in Idaho and adjacent states. Lodgepole pine has been practically wiped out over thousands of acres in the Rocky Mountain states and much valuable ponderosa and sugar pine has been killed in the Pacific Coast states, particularly in California.

Habits and Work: This species usually attacks trees in clumps rather than selecting individuals as is the custom of *D. brevicomis*. The main bole, from a few feet above the ground up to the limbs, is the most attractive portion, but the attack may extend from the ground to the top. Living trees are regularly attacked, but if available, down logs, tops, large limbs, weakened, fire killed, or otherwise damaged trees may be selected.

Pitch tubes and borings give ample evidence of attack and the foliage of attacked trees soon fails.

Egg tunnels are vertical (with the grain of the wood) in the cambium, nearly straight to slightly winding, and from 1 to 3 feet long. Almost invariably there is a short lateral at the end of the gallery which serves as a
turning niche. Egg niches are deep, placed alternately along the sides of the gallery at intervals of half an inch or more.

The larval mines are short, averaging about a foot in length, and as a rule, both they and the pupal cells are entirely in the cambium, although some pupal cells may be in the bark. Emergence is through individual exit tunnels. Usually there is a single generation per year, but owing to brood unevenness adults will be found emerging at various times from June to September.

*Dendroctonus jeffreyi* Hopkins 09:114 The Jeffrey Pine Beetle

This is a large species, being 6 to 7.5 mm. long and black; front convex, without groove; elytral rugosities moderately coarse and dense, finer near vertex and laterally. Pronotum with very fine, shallow punctures which serve to distinguish it from *D. ponderosae* and *D. monticola* to which it is related.

Fig. 36. Adult *Dendroctonus jeffreyi* (By Hayes)

**Type locality:** Little Yosemite, California.

**Distribution:** Extreme southwestern portion of Oregon and through the range of its host tree in California.

**Host:** *Pinus jeffreyi*, *P. ponderosa* and *P. lambertiana* have been reported as hosts but these are in error.

**Work:** The mines (fig. 37) are quite similar to those of *D. monticola*, but shorter, and there is usually a distinct angle at the bottom of the egg gallery. Long (2 to 3 feet), nearly straight egg galleries are in the cambium. The larval mines are exposed in the cambium and are largely across the grain of the wood. Pupal cells are exposed when the bark is removed. There is one generation annually.

**Remarks:** The species is a primary enemy, and epidemics over limited areas are often very destructive. The principal period of attack is
during July and August. It seldom attacks logs or slash and prefers trees on poor sites or those which are unhealthy due to drought, defoliation or other causes.

The beetle’s large size, the character of the mines, and especially the species of host tree will serve to identify this species.

*Dendroctonus pseudotsugae* Hopkins 09:126 The Douglas-fir Beetle

Length, 3.5 mm. to 7 mm., average nearly 6 mm.; the color dark brown to nearly black, elytra often reddish; the epistomal process with the sides parallel and with its anterior margin usually projecting slightly beyond the margin of the epistoma; the pronotum shining, finely, and closely punctured, with a few larger punctures intermixed.

Type locality: Grants Pass, Oregon.

Distribution: Throughout Rocky Mountain and Pacific Coast states and in Western Canada, where Douglas-fir is found.


Work: The galleries (fig. 39) of this species are from \(\frac{1}{2}\) foot to over 3 feet in length, running with the grain of the wood. They lie in the cambium, engraving the wood slightly or not at all, and are often much wider than would appear necessary for the passage of the beetle. Eggs are deposited in grooves which alternate on either side of the gallery; such grooves are usually from 3 to 6 inches long and contain, on the average, from 6 to 24 eggs. The grooves are separated from each other and the main tunnel by tightly packed reddish borings and frass. Larvae mine out at more or less right angles, but separate more and more as they progress so that the whole presents a fan-like appearance for each groove. Both the larval mines and about half the pupal cells are exposed upon removal of the bark. Many fully developed larvae mine into the inner bark where they pupate. These are not seen when bark is removed.
There is one generation each year, with two broods. Many adults, after completing their egg gallery and depositing their complement of eggs, remain in the tunnels for several weeks. They then emerge to attack another host and deposit eggs for a second brood.

Habits and importance: In Pacific Coast states where Douglas-fir finds its optimum conditions and the trees reach very large size, this beetle is generally of only secondary importance. With present methods of logging, there is an overabundance of stumps, broken and otherwise defective fresh logs, large limbs, and other debris left after logging. This material furnishes ample opportunity for the beetles to feed and as long as this class of material is available, they seldom attack living trees. However, it has been amply illustrated that when such material is lacking, they can and do attack the living, second growth timber (Chamberlin 18:23-24). East of the Cascade range, particularly in eastern Washington and Idaho the species has assumed major importance, killing quantities of Douglas-fir, and invading timber defoliated by the spruce budworm or other defoliators. It has been realized for years that the Douglas-fir beetle was a potentially dangerous insect since small, restricted outbreaks occur almost every year. This is particularly true in Idaho, eastern portions of Oregon and Washington, and in eastern British Columbia where Douglas-fir does not enjoy the optimum conditions that it has west of the Cascade range. However, the balance can be easily upset when some unusual conditions arise such as the rather severe epidemic following the Tillamook burn, and in the winters of 1949-50 and 1950-51 when great quantities of Douglas-fir were blown down in various areas of the Northwest. The extent of this blowdown has been estimated at more than 9 billion board-feet of timber, and green timber attacked and killed by emerging broods has amounted to about three billion board-feet. Some of this timber will be salvaged but quantities will remain and constitute a fire hazard. This is an excellent example of what may happen when conditions become very favorable for any species of bark beetle.

Winter is passed (at least in the Pacific Coast region) largely in the young adult stage, although a considerable number of larvae are to be found, particularly those of the second brood. Adults often congregate in numbers in hibernating galleries to pass the winter and emerge early in the spring.

Fig. 39. Gallery of *Dendroctonus pseudotsugae*
Apparently some adults live over a second winter. Emergence from winter quarters starts early in April at lower elevations and continues throughout the summer. Although many species of Scolytidae show a very decided preference for bark of a certain thickness, this species does not seem to show any preference, attacking second growth trees when the bark is little more than ¼ inch thick, but it is also found excavating long entrance tunnels through bark 5 inches thick. The species is monogamous. The females do practically all of the excavating and deposit from 20 to 100 eggs or more in grooves, as explained above. The cycle from egg to adult requires 7 to 10 weeks, depending on temperature.

*Dendroctonus engelmanni* Hopkins 09:130 The Engelmann Spruce Beetle.

The adult beetle is cylindrical, reddish-brown to black, and 5 to 7 mm. long. The body is sparsely clothed with long hairs. It differs from *D. obsesus* by the darker pronotum and more distinctly impressed lateral striae of the elytra, with coarser punctures. The host, distribution, and type of work serve to distinguish the species.

**Type locality:** Capitan, New Mexico.

**Distribution:** Eastern Washington and Oregon, also in Idaho, Montana, Wyoming, Colorado, Utah, Arizona, and New Mexico, and in the Black Hills of South Dakota.

**Hosts:** Primarily Engelmann spruce (*Picea engelmannii*) and lodgepole pine; also other species of *Picea* within their range.

The Engelmann spruce beetle is the most serious pest of Engelmann spruce forests in the United States and the severe epidemic which covered much of the Rocky Mountain region from about 1940 to 1953 enabled entomologists to make a thorough study of the species. Massey and Wygant’s circular (1954) gives a complete account of the species.

According to these authors, these insects destroyed 3.8 billion board-feet of Engelmann spruce and 500 million board-feet of lodgepole pine in Western Colorado from 1939 to 1951. Large quantities of the above species were also killed in New Mexico, Wyoming, and Idaho, with smaller epidemics occurring in British Columbia. The attacks seem to have had their beginnings in large blowdowns in various areas of Engelmann spruce regions.

Although there is ample evidence that this species was epidemic some 50 years ago, and had killed large quantities of its host trees, it had not been a serious pest during the intervening years. Only when instigation of control work became imperative was it realized that very little accurate information as to life history and habits was available.

It was found that the beetles had two distinct periods of emergence, one in June-July and the other in August-September. Beetles emerging in the
first period attack new hosts while those maturing in the latter period go into hibernation in the pupal cells. Most of the “second crop” adults emerge to attack the following June-July.

At lower elevations the beetles complete a life cycle in a single year, but at higher elevations they require two years and in some cases individuals evidently need three years to complete a cycle. Apparently, after completing a gallery and depositing eggs, some beetles emerge to make a second tunnel and deposit eggs for another brood.

Attacks are made in lower portions of the trunks of the host tree and large trees are selected when available. As trees are killed off and the beetles become more numerous, however, it was observed in Colorado that they would attack saplings having 2-inch diameters.

Measurements of 218 egg galleries by Massey showed a maximum length of 9 inches, a minimum of 2 inches, and an average of 5 inches. Eggs are deposited along the sides in groups or rows and on alternate sides of the gallery in a manner similar to the Douglas-fir beetle. Egg counts in 136 galleries showed a maximum of 144 (6.1 inch gallery) and an average of 20.5 per inch of gallery. The egg tunnel extends up the bole from the entrance with a turning niche below the entrance which is often blocked with pitch and borings. Ventilation holes through the bark are made at intervals. Niches about the length of the body extend into the wood on opposite sides of the main tunnel and apparently serve as turning niches since they do not contain eggs.

Infested trees fade slowly and do not show the pitch tubes so noticeable in trees attacked by *D. brevicomis*, *D. monticolae*, and others. Needles may remain green for as long as two years after attack. The presence of red boring dust around the base and the ventilation holes give evidence of attack.

Like many other bark beetle species, *D. engelmanni* has an associated blue-stain fungus which was identified as *Leptographium* sp.

During epidemics the trees contain more larvae per square foot than are found in other species of the genus, ranging from 66 to 542 per square foot of bark. There is a heavy natural mortality; estimated at about 75%, due to parasites, predators, competition for food, and adverse temperatures. Woodpeckers were credited for reducing the beetle population in many areas by 50%.

Temperatures as low as -56° were recorded in the Rocky Mountain area and laboratory tests showed -15° fatal to adults, but it required -30° to kill the larvae. Since many adults hibernate below the snow line they are unaffected by even extreme temperatures.

*Dendroctonus borealis* Hopkins 09:133 The Alaska Spruce Beetle

*D. borealis* is closely related to *D. engelmanni* and *D. obesus*. It is black with reddish elytra in the male, 6 mm. long; front of head convex, striae of elytral declivity not deeply impressed, interspaces scarcely rugose except at base and vertex. The form is shorter and stouter than in the allied species, striae finer and less distinct.
This species is difficult to separate from *D. engelmanni* and *D. obesus* and, as Swaine (17:66) remarks, these three spruce feeding forms may simply be varieties of a single species.

Type locality: Eagle, Alaska.

Distribution: Alaska and northwestern Canada, south into British Columbia.

Hosts: *Picea canadensis* and *P. engelmannii*.

Habits and work: Galleries are very similar to those of *D. engelmanni*. Attack is usually confined to windthrown trees or those injured by fire, storm, or other causes, but under favorable conditions it becomes a primary enemy and has caused the death of large quantities of spruce in the Canadian Rockies and Alaska.

*Dendroctonus obesus* Mannerheim 43:296 The Sitka Spruce Beetle

A rather stout, black species, 6 to 7 mm. long; punctures of the striae, coarse and distinct; form more elongate than in *borealis*, and more densely hairy. Swaine (18:67) states, "At present I am of the opinion that *obesus*, *borealis*, and *engelmannii* form one variable species, with *piceaperda* only doubtfully distinct." Geographical locations in which specimens are collected, together with host identity, would seem the most reliable keys to the species as presently known.

Type locality: Russian America, exact locality not recorded.

Distribution: South from Alaska, along the coast to southern Oregon.

Hosts: Sitka spruce, *Picea sitchensis*.

Work: Galleries are very similar to those of *D. engelmanni*.

Importance: Normally this species is of secondary importance, but at times becomes primary. Every year along the coast a considerable amount of Sitka spruce is damaged by ground and brush fires, or by clearing operations for roads, homes, or agricultural use. Such material is almost sure to be attacked by *D. obesus* and *Ips* spp.

In 1933, quantities of large, mature, and apparently healthy Sitka spruce were found heavily attacked and dying from the work of this species. The timber was adjacent to the big timber blowdown on the Olympic Peninsula of Washington. Perhaps the beetles had built up in the windthrown material to a degree allowing them to successfully attack the apparently healthy material, in the same manner that *D. pseudotsugae* built up after the "big burn" in Tillamook County, Oregon. An epidemic on Kosciusko Island in Alaska killed more than 35 million board-feet of Sitka spruce from 1943-1946.

*Dendroctonus murrayanae* Hopkins

09:140 The Lodgepole Pine Beetle

The adult beetle (fig. 41) is stout, cylindrical, 5.5 to 6.5 mm. long. The prothorax is dark brown to black and the elytra reddish; the striae of the elytra are distinctly impressed on the dorsal and lateral areas; interspaces finely, densely punctured.

Fig. 41. Adult *Dendroctonus murrayanae* (By Hayes)
Type locality: Keystone, Wyoming.
Host: Lodgepole pine *Pinus contorta*. Hopkins (09:142) gives *Picea engelmannii* as a host. This is questionable.

Work: Entrance tunnels are usually near the base of the tree, seldom more than five feet from the ground. They are easily recognized by the very large pitch tubes around the entrance hole. The egg gallery is similar to that of *D. valens*; parallel to the grain of the wood, from 5 to 12 inches long, and entirely in the cambium. Eggs are placed along each side of the gallery and the larvae work out en masse, there being no individual larval tunnels. The pupal cells are in the inner bark. There is one generation per year.

Notes: Keen (38:109) makes the following remarks on this species, “Ordinarily it is not an aggressive enemy, but it occasionally does kill over-mature lodgepole pine left standing following the operations, timber sales, or other cuttings. Fortunately, such outbreaks die down at the close of the operation. In some instances trees are killed during the first year by the basal attack—or it may require three or four successive years of attack before the resistance of the trees is sufficiently lowered to render them attractive to other bark beetles. In other cases they are abandoned by the insects before the attacks prove fatal. In any case, this basal damage to the tree may be considered as primary, as it is the first weakening influence.”

*Dendroctonus valens* LeConte 60:59 The Red Turpentine Beetle

This is the largest species of the genus, measuring from 5.5 to 9.5 mm. in length. The reddish color, large size, head without frontal groove, and more numerous hairs on the anterior dorsal part of the elytra will serve to distinguish it.

Type locality: California.

Distribution: *D. valens* is the most widely distributed species, not only of this genus, but of the entire family Scolytidae in North America. It is found in practically all coniferous regions of North America except the extreme southeast, occurring in Alaska, south through Rocky Mountain and Pacific Coast states, through Mexico to Guatemala; across Canada to Labrador, throughout the Lake States south to Carolina, and west around the Gulf into Mexico.

Fig. 42. Adult *Dendroctonus valens*
Hosts: All the pines within its range, several species of spruce, at least one fir and one larch, and rarely in other conifers. Pinus ponderosa, P. sabiniana, P. strobus, P. monticola, P. radiata, P. rigida, P. lambertiana, P. contorta, P. edulis, P. strobiformis, P. leiophylla var. chihuahuana, P. jeffreyi, P. sylvestris, P. virginiana, P. coulteri, P. arizonica; Picea canadensis, P. excelsa, and P. rubens; Abies concolor, Larix laricina, and Pseudotsuga menziesii. Bedard (38:194) reports this species as common in basal portions of Douglas-fir in Idaho.

Work: Attack is always near the base of the tree, never more than six feet from the ground. The tunnels are from a foot or less to quite long. (Patterson reports finding a gallery some 15 feet long and largely underground, following the cambium of a root.) Eggs are deposited in masses along gallery sides and the larvae work out gregariously, destroying large areas of bark. This bark ultimately cracks, breaks away, and leaves large basal scars. Recently dead, dying, and injured trees as well as windthrown trees, logs, and stumps are preferred, but at times living, healthy trees are attacked and trees attacked by other bark beetles are attractive. Serious damage to Monterey pine has been reported from California parks, and many trees were killed in plantings in the Nebraska National Forest.

10 Genus PHLOEOSINUS Chapuis 69:37

(Blackman 1942)

This is a very large genus containing some 40 species in the United States. They are remarkably similar in morphological characters and in habits. All except 3 of the 39 species attack only the cedars, junipers, redwood, cypress, and related trees. One species has been reported from spruce, one from pine, and one from Douglas-fir.

Many of the species are difficult to separate and possibly some of those now recognized may eventually prove to be synonyms. Collectors should gather all possible data when collecting specimens as to host, part of the tree attacked, examples of the work, and exact locality, all of which will aid in separating closely allied species.

The genus is characterized by the head being visible from above, antennal funicle of five segments which widen distally, a conical club being much longer than wide, sutures oblique. Elytral declivity has alternate (1, 3, etc.) interspaces tuberculate, more strongly in the male (fig. 43). The presence of declival tubercles is probably the most pronounced character of the species of Phloeosinus.

Some 18 species occur in the Northwest; thus the genus ranks second in number of species in this territory.
Key* to Species of PHLOEOSINUS of the Northwest

1. Epistomal lobe narrow, moderately long; mesosternum precipitous and protuberant between coxae. In twigs of Douglas-fir. **PSEUDOSUGAE** Chamb. Epistomal lobe small or nearly absent, mesosternum without protuberance. In Cupressinaceae trees

2. Second interspace on elytral declivity subequal or narrower than first or third, never serrate

3. Second interspace on declivity as wide as first or third, (usually serrate in female, not so in the male)

4. Species small, usually under 2.0 mm. long (except **keeni**), mesosternum precipitous or steeply oblique between the coxae; vestiture of pronotum and elytra usually rather abundant and distinct

5. Species usually larger (2.0 to 4.5 mm. long); mesosternum ranging from flat to moderately oblique between the coxae; vestiture of pronotum and elytra usually scant except sometimes quite evident on the declivity

6. Elytra of male more than 1.30 times as long as wide, interspaces not twice as wide as striae; first and third interspaces of the declivity with coarse, short, stout, closely placed, recurved serrations. Frons of male narrowly concave with distinct, elevated carina on lower half. **HOPPING** Sw.

7. Elytra of male less than 1.30 times as long as it is wide (except in **antennatus**), interspaces more than twice as wide as striae; first and third interspaces on declivity sparsely armed with either rather small, or slender, sharp serrations

8. Large species (2.15 to 2.8 mm. long); frons of male deeply and widely concave, with carina moderately elevated on less than lower half; elytral striae narrow, with small close punctures. **KEENI** Blkm.

9. Smaller species (1.6 to 2.0 mm. long); frontal cavity of male only moderately deep and rather narrow, with strong sharply elevated carina on more than lower half; elytral striae moderately narrow; strial punctures larger and not closely spaced; declival serrations small. **ANTENNATUS** Sw.

10. Only moderately shining; elytral striae strongly, moderately wide, with coarse punctures (exceptions); serrations of first and third interspaces about equally developed in both sexes, sometimes those of the first interspace of males obsolete near the apex

11. Elytral declivity with first and third interspaces scarcely serrate in either sex, second interspace subequal in width or slightly narrower than others

12. Elytral declivity with first and third interspaces in both sexes distinctly serrate, second interspace noticeably narrower than first and third

13. Elytra brilliantly shining, appearing glabrous on disk and sides, but with scanty, minute hairs, striae but little narrower than interspaces, with coarse, shallow punctures; declivity with second interspace impunctate and bare of hairs in male; third interspace strongly elevated and closely, coarsely serrate. **PUNCTATUS** LeC.

14. Elytra a little less brightly shining, with moderately scanty, fine, short (but not minute) hairs on disk and sides, striae distinctly narrower than interspaces, with notably smaller punctures; declivity with second interspace sparsely to very sparsely punctured in male, with few or many hairs; third interspace moderately elevated, with serrations moderately small and sparse

15. Pronotum with discal punctures similar throughout, with much longer, stouter hairs at each side; elytra with interspaces about 1.5 times as wide as striae; declivity of female densely clothed with hairs and scales; first interspace of male with sparse serrations. **RUBICUNDULUS** Sw.

* Adapted in part from Blackman 1942:406-407.
PLATE IV

Galleries of Phloesinus

Figures A, B, C, D U. S. Forest Service Photographs
Frontal concavity of male less than half as wide as the distance between eyes; pronotum with punctures notably smaller and closer together in the median line than elsewhere on the disk, hairs at sides not much longer or stouter than elsewhere; elytra with interspaces twice as wide as striae; declivity of female rather thinly clothed with hairs or scales .............................................................. 10

1. Frons of male distinctly concave; pronotum with median line more finely and closely punctured; elytra with interspaces twice as wide as striae; declivity of female rather thinly clothed with hairs or scales .............................................................. 10

10. Small species (1.9 to 2.3 mm. long); elytral declivity of both sexes devoid of scalelike hairs ............................................................. BUCKHORNI Blkm.

Larger species (2.14 to 3.1 mm. long); elytral declivity of female with scalelike hairs .................................................................................. 11

11. Frons of male rather coarsely granulate-punctate at sides and above, median carina rather short, one-third the diameter of deep concavity; declivity of female with rather wide, scalelike hairs ............................................................. KANIKSU Blkm.

Frons of male finely granulate-punctate at sides, punctate above; median carina long, two-thirds the diameter of rather shallow concavity; declivity of female with rather narrow scalelike hairs ............................................................. RUSTI Blkm.

12. Elytral interspaces nearly smooth except near the declivity, species small and slender in_ Chamaecyparis nootkatensis_ .......................................................... NITIDUS Sw.

Elytral interspaces rugose and sparsely granulate punctuate, with minute sparse hairs on disk ........................................................................... SEQUOIAE Hopk.

13. Smaller (1.8 to 2.25 mm. long); pronotum with small, moderately sparse punctures; elytral striae with very fine punctures, interspaces punctate and with only a few very fine granules; declivity with first and third interspaces weakly convex, each with a few minute, obsolescent granules ...................................................................................................................... VAN YK REI Sw.

Larger (2.0 to 2.8 mm. long); pronotum with moderately coarse, close punctures; elytral striae with moderately large punctures; interspaces densely, moderately coarsely granulate-punctate; declivity with interspaces 1 and 3 strongly convex, with a few small granules .............................................................. 14

14. Black throughout; frons strongly granulate-punctate throughout, including shallow concavity; pronotum with dense, deep punctures; elytra black, interspaces very densely, rather coarsely granulate; second declival interspace subequal in width to first or third ............................................................. FULGENS Sw.

Black, with elytra reddish-brown; frons granulate-punctate at sides, punctate above; pronotum with close, deep punctures; elytra reddish-brown, moderately densely, less coarsely granulate; second declival interspace slightly but distinctly narrower than first or third ...................................................................................................................... S PLENDENS Blkm.

15. Elytral declivity of female with second interspace serrate throughout (except some jumperi); male with 1 or 2 small tubercles near the apex of second interspace .............................................................. 16

Elytral declivity with second interspace entirely devoid of serrations or tubercles in both sexes .................................................................................. 17

16. Frons of male strongly granulate-punctate, not rugose; disc of pronotum deeply, moderately closely punctured; discal vestiture of elytra moderately abundant, short and decumbent. First declival interspace of male with large serrations moderately closely placed ................................................. JUMPERI Sw.

Frons in both sexes finely granulate punctate at sides; discal vestiture short fine with inconspicuous pubescence. Declivity with first, third, and alternate interspaces rather strongly convex, first and third closely, finely punctured with unserrate row of small serrations; fifth and seventh interspaces with 2 to 4 similar serrations ......................................................................................................... CHAMBERLINI Blkm.

17. Frons of male distinctly concave; pronotum with median line more finely, closely punctured; elytral striae narrow, moderately, finely, indistinctly punctured ................................................................. RUGOSUS Sw.

Frons of male transversely impressed, sometimes deep in median area but not concave; pronotum with median line not more finely and closely punctured; elytral striae narrow to very narrow with small, usually indistinct punctures; antennae with all sutures distinctly oblique ........................................................................... SCOPULORUM Sw.
**Phloeosinus pseudotsugae** Chamberlin 55:117

Color black, with brick-red elytra, length 1.6 to 2.06 mm., antennal club twice as long as wide, first suture sinuate, septate for more than half its length, second straight and septate, third suture nearly obsolete. Pronotum surface uniform—coarsely, closely punctured, not granulate, median line scarcely evident except near the base. Elytral interspaces slightly wider than striae. Striae strongly elevated, wider than the interspaces on the declivity. Second interspace narrower than 1 or 3, serrations feeble; first and third interspaces distinctly more elevated than the second. First and second striae coalesce near the apex of the elytra; interspaces with numerous scalelike hairs.

Type locality: Tiller, Oregon (Douglas County).

Distribution: Known only from type locality.

Host: Douglas-fir.

This species can be recognized by its very small size and its host as well as by the characters given above.

It is the third* species of the genus found to attack trees other than those of the Cupressinae group. It works in small twigs (¼ inch in diameter) of healthy Douglas-fir. The type series came from twigs which for the most part were attacked by *Cylindrocopturus furnissi*. Which of the two species entered first was not determined. The twigs were almost completely mined so that the type of tunnel could not be ascertained.

**Phloeosinus hoppingi** Swaine 15:364

This is a very small species (length 1.9 mm.), dull brown to black, front of head rather roughly punctate with a deep, transverse impression and well developed median carina, a dense, yellow fringe of hair on the epistoma. Pronotum longer than wide (6:5); disk coarsely, not densely, punctured; elytral striae deep, quite narrow, punctures small; interspaces convex, closely, coarsely granulate-punctate, a single line of coarse asperities on each interspace on the disk and alternately on the declivity: first interspace asperate only on the anal half, second asperate only on the basal half, third for its entire length, fifth and seventh distinctly asperate on the anal half only; declivity with alternate interspaces more strongly convex.

* Wood (57:400) places this species as a synonym of *antennatus* Sw., however, the host and type of work is entirely different and we are not prepared to accept this synonymy.

* Wood (57:400) places *P. picea* Sw. as a synonym of *P. pini* Sw.
Type locality: California.
Distribution: British Columbia to California in the mountain areas.
Hosts: Incense-cedar (*Libocedrus decurrens*) and Rocky Mountain red cedar (*Juniperus scopulorum*).

Habits and work: This is one of several species of the genus which confine their attacks to twigs and branches. The egg gallery is variable, it may be quite straight or winding, single or branched, and is from \( \frac{1}{2} \) to \( 1\frac{1}{2} \) inches long. 

Larval mines are also more or less irregular depending upon the direction of the egg gallery. A typical gallery in incense cedar shows 21 egg niches. The attack is usually made on twigs or branches less than one inch in diameter.

*Phloeosinus keeni* Blackman 42:414.

Black, with reddish-brown elytra; length 2.15 to 2.8 mm. Antenna with club slightly less than twice as long as wide, first two sutures slightly but distinctly oblique, third suture strongly, sinuately oblique.

Disk of the pronotum with close, deep, moderately fine punctures, no elevated median line. Elytral surface moderately shining on the disk; striae narrow, punctures small, rather close; interspaces several times as wide as striae, finely, closely punctate-granulate; a uniseriate row of large asperities on the first, third, and alternating interspaces, starting near the summit of declivity. Declival interspaces closely punctured, with short, flattened, scale-like, recumbent hairs, with a few semierect setae; first and third interspaces strongly convex.

Type locality: Mount Rainier National Park, Washington.
Distribution: Washington, the type locality, and Fairfax.
Host: *Alaska yellow cedar* *Chamaecyparis nootkatensis*.

This species was reared from small branches of the host tree. The work has not been seen by the writer.

*Phloeosinus antennatus* Swaine 24:146.

Length 2 mm.; black with reddish antennae and the elytral declivity reddish-brown; head with front transversely impressed, distinct median carina; pronotum as wide as elytra; surface roughened, deeply, closely punctured; elytral interspaces convex with a coarse row of granules on the disk; striae deep with distinct punctures which are longer than wide; declivity with first and third interspaces convex, feebly, sparsely serrate; pubescence short, stout, and distinct, scalelike on the declivity. Closely related to *swainei* but more slender; interspaces narrower and more rugose; declival pubescence more scalelike and the caudal half of the elytra is red-brown.

Type locality: Strawberry, California.
Distribution: Middle Sierras of California to Southern California. Oregon records given by Blackman (42:416); Pinehurst, Phoenix, Wonder, and Wapinitia.

Host: Incense-cedar (*Libocedrus decurrens*).

Habits and work: The type series was taken by the writer from a small incense-cedar, 5 inches in diameter. From near the ground to well up in the limbs the cambium was completely riddled with egg galleries often touching
or crossing one another. These mines are short, from \( \frac{1}{2} \) to 1 inch long, vertical, and running down from the entrance hole. As is usual with species of this genus there is a short lateral spur (about 1 to 1\( \frac{1}{2} \) mm, long) at the base of the entrance tunnel used as a turning niche. The eggs are in well separated niches and from 12 to 25 eggs are found in each tunnel. Larval mines are very irregular (probably due to the crowded conditions), and usually run more or less obliquely. All tunnels, egg and larval, lie almost entirely in the bark, scarcely engraving the wood. Keen (38:32) reports the species as mining twigs and limbs.

*Phloeosinus punctatus* LeConte 76:382. Western Cedar Bark Beetle

Medium size species (2.14 to 3.2 mm. long). Black with reddish elytra, somewhat shining. Frons densely granulate-punctate at sides and above. Central area deeply concave, smooth, and shining; elevated median carina on lower fourth. Antennal club about twice as long as wide, sutures all strongly oblique and sinuate. Pronotum strongly constricted on anterior third; disk with deep, close, coarse punctures, somewhat roughened but not granulate.

![Fig. 44. Adult *Phloeosinus punctatus*](image)

Elytral striae nearly as wide as interspaces, with large, very shallow punctures. Declivity (fig. 45) with interspaces slightly wider than striae, convex, rugose, and granulate; first, third, and alternate interspaces rather strongly elevated and strongly serrate, third interspace regularly and strongly serrate to apex where it meets the ninth interspace; fifth and seventh with 3 to 5 smaller serrations, ninth with few serrations.

Type locality: Oregon (exact locality not given by LeConte).

Distribution: Washington, Oregon, and California.

Oregon: Generally distributed where the host trees are found.

Hosts: Western red cedar (*Thuja plicata*), incense-cedar (*Libocedrus decurrens*), are common hosts. Blackman (42:431) reports western juniper (*Juniperus occidentalis*). The species has also been reported from Port-Orford-cedar (*Chamaecyparis lawsoniana*) and Alaska-cedar (*C. nootkatensis*) by Van Dyke and Chamberlin (39:471); however, several closely related species have been described since the last two records were made and the original insects should be checked.

Work: The egg gallery (plate IVA) of *P. punctatus* is typically a single short tunnel in the cambium, engraving both bark and wood. It is vertical (with the grain of the wood) and typically only about one inch long (one gallery noted having a length of 2\( \frac{1}{2} \) inches) and often only \( \frac{1}{2} \) to \( \frac{3}{4} \) inch in length. Less frequently there are two short tunnels leading from the turning niche forming a "V." Entrance tunnel and turning niche are usually at the base of the egg tunnel, or tunnels. The turning niche varies in shape; it may have
a short offshoot to one side, or may be a small, irregular enlargement above the entrance tunnel. Egg niches are more widely spaced than in most species and hence are fewer in number; ranging from 13 niches in galleries that averaged \( \frac{1}{4} \) inch in length, to 37 niches in a gallery 2\( \frac{3}{4} \) inches in length. Larval mines extend horizontally for a short distance and then proceed at an angle up or down the tree; pupal cells are largely in the bark.

**Phloeosinus Declivities.**

![Declivities of Phloeosinus](image)

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**Phloeosinus rubicundulus** Swaine 24:144

Length, 3 mm.; color, black with red-brown elytra; front of head convex, coarsely, not deeply punctured, median line smooth, carinate anteriorly; pronotum strongly narrowed from the base, surface somewhat rough, moderately closely punctured; elytral striae deeply and coarsely punctate, interspaces wide and convex on the disk, very coarsely rugulose, uniseriately granulate at the declivity. The declivity (fig. 45c) of the female shining, striae deeply impressed, punctures small; first and third interspaces feebly serrate, second narrower than others, not serrate. The male with the first interspace of the declivity feebly elevated, with three widely separated serrations.
Closely allied to *nитидус*. The pronotum is narrower than in *nитидус*, also the stria l punctures of the elytra are smaller and the declivital serrations are much more feeble.

Type locality: Hassack Meadows, Tulare County, California.
Distribution: California and Oregon. In Oregon the species has been taken in the Coos Bay area, and the Willamette Valley.
Hosts: Redwood (*Sequoia gigantea*), incense-cedar (*Libocedrus decurrens*), and Port-Orford-cedar (*Chamaecyparis lawsoniana*).
Notes: This species has been considered rather uncommon and is of interest principally because it is one of the few species of bark beetles attacking giant redwoods. However, in 1953-54 there was a widespread epidemic during which thousands of Port-Orford-cedar trees were attacked along the Oregon coast, particularly in Coos County. Ornamental trees were killed over much of the Willamette Valley. Attacks were made in tremendous numbers on individual trees; for example, 1,333 adults were obtained from one section of a Port-Orford-cedar limb 24 by 18 inches. Many of these trees were suffering from root fungi, making them attractive to the beetles.

Typical egg galleries (plate IV,H) are nearly straight with the grain of the wood, from 1 to 2½ inches long and may extend either up or down from the entrance. The turning niche is somewhat variable, usually well back from the gallery entrance. Very often there is a chamber twice as long as it is wide at the far end of the gallery, with its own width at least twice that of the gallery. Quite often the end is a half loop, like a fish hook. The number of egg niches found in 22 galleries, varied from a minimum of 19 to a maximum of 55, average 35. Larval mines are very irregular, seldom straight, often crossing, at times looping back and having an average length of about two inches. All work is in the cambium and when the attack is heavy the entire cambium is completely destroyed. Attack was on all parts of the tree trunk and limbs in the area of the epidemic.

*Phloeosinus buckhorni* Blackman 42:433

Length 1.9 to 2.3 mm. Black, with shining, bright, reddish-brown elytra. Club of antenna less than twice as long as wide, sutures distinctly oblique, third strongly so and sinuate. Disk of pronotum deeply, rather closely, somewhat finely, and roughly punctured.

Elytral striae about half as wide as interspaces, punctures rather small, very shallow and usually indistinct, interspaces convex, rugose-granulate, with fine punctures. Declivity with first, third, and alternate interspaces strongly convex; first with moderately small serrations, those on third larger and more numerous; fifth, seventh, and ninth interspaces with a few sharp asperites or granules.

Allied to *punctatus*, but smaller with more numerous and larger hairs on dorsal surface; elytral striae narrower and strial punctures smaller.

Type locality: Portland, Oregon.
Distribution: Oregon from Portland and Pinehurst.
Host: *Thuja plicata* and *Libocedrus decurrens*.
The only galleries of this species examined by the author are those in the collection of the Forest Insect Laboratory, U.S. Forest Service, Portland, Oregon in *Thuja plicata*. They are short, rather broad, and engrave the wood deeply. They are vertical with a very pronounced turning niche somewhat above the entrance tunnel; egg niches are large and the number of eggs averages about fifteen. The larval mines are very irregular and run at an angle (plate IV, C).

*Phloeosinus kaniksu* Blackman 42:434

This species is very close to *rubicundulus* and *punctatus* and except that the galleries are quite different and this species attacks only medium to small limbs we would be inclined to place it as a synonym of *rubicundulus*.

Blackman (42:435) remarks, “This species is most readily distinguished from *punctatus* and *rubicundulus* by the more rugged sculpture of the discal interspaces of the elytra; the more abundant and conspicuous discal vestiture; and by the vestiture of the elytral declivity which is notably better developed than in *punctatus* and in the females is less scalelike and much less abundant than in *rubicundulus*.”

Type locality: Metaline Falls, (Kaniksu National Forest) Washington.


Washington: Type locality and Northport.

Oregon: Corvallis, Coos Bay, and Keno (Klamath County).

Idaho: Pierce and Kootenai Counties.

Hosts: *Thuja Plicata* and *Chamaecyparis lawsoniana*—new host.

A considerable series were bred from limbs of Port-Orford-cedar at Corvallis where they were killing a hedge. Specimens were also bred from limbs of the same host collected at Coos Bay, Oregon.

The typical gallery (plate IV, B) is somewhat narrower than those of *P. rubicundulus* and although it runs more or less longitudinally it is seldom exactly with the grain of the wood but more at an angle, and when crowded may be nearly across the grain. The length is from 3/4 to 1 1/2 inches, occasionally a little longer, scoring the wood lightly. Egg niches are somewhat irregular; tunnels have been noted where 80% of the niches were on one side of the gallery. There is a small turning niche either at the very start of the gallery or slightly above the entrance. Egg numbers are less than in *rubicundulus*, ranging from 12 to about 40. Usually the larval mines are almost entirely in the bark, as are the pupal cells. Larval tunnels are very irregular, winding about and often crossing.

Our series were bred from branches 1/2 to 3/4 inches in diameter.

*Phloeosinus rusti* Blackman 42:435

Similar to *punctatus*, black with reddish-brown elytra; length 2.23 to 3.00 mm. Pronotum slightly wider than long; disk moderately finely, very deeply, and rather closely punctate.

Elytral striae impressed, about half as wide as interspaces, punctures small, close, not deep. Declivity with interspace narrow, nearly flat, smooth, and impunctate, first and third strongly convex; first interspace with mod-
erately small serrations; fifth, seventh, and ninth interspaces each with a few small serrations.

Type locality: Metaline Falls (Kaniksu National Forest), Washington.

Distribution: Type locality, Wind River, Washington, and British Columbia.

Host: *Thuja plicata*

Nothing of the biology of this species has been recorded. The species will probably be found on the Oregon side of the Columbia River. Stace Smith reports collecting this species in British Columbia.

*Phloeosinus nitidus* Swaine 24:145

A small (length 2.5 mm.), somewhat elongate species; black with piceous elytra. Closely allied to *rubicundulus*; front of head granulate-punctate with a large median concavity; pronotum similar to *cypessi*; lateral interspaces of the elytra nearly smooth, except near the declivity; discal interspaces very coarse, sparsely granulate.

Type locality: Near Detroit in the Santiam National Forest (name changed to Willamette National Forest), Oregon.

Distribution: Oregon and Washington. Wood reports the species from British Columbia.

Notes: The type was taken by the writer near the base of Battle-ax Mountain, Linn County, Oregon, from dead cedar. This is the southern extremity of the distribution of Alaska-cedar and most of the trees in the vicinity were dying or dead. Some showed considerable basal injury from fire. The mines of a cerambycid (*Atimia dorsalis*) were abundant on the main trunks. Intermingled with these were the mines of *P. nitidus*. In most cases the latter were more or less obliterated by the cerambycid tunnels and undoubtedly many of the bark beetles died from lack of food. The typical scolytid tunnels (plate IV, E) were straight, longitudinal, and about 3 inches long. They progressed up from the entrance tunnel and invariably showed a very short spur just above the point where the cambium was reached. The egg niches are very close together, the average mine showing about 100 niches. The larval tunnels started at right angles but quickly assumed a vertical direction. In almost every case a few mines cut across others.

*Phloeosinus sequoiae* Hopkins 03:33

Synonyms: *P. squamosus* Blkm. 42:448

  *P. blackmani* Schedl 50:36 (new synonymy)

Hopkins' original description simply states "It is a medium-sized, stout, black beetle."

This is one of the largest species in the genus, 3.25 to 4.24 mm. long, dark mahogany-brown to black in color, and at once distinguished by the large size and by having the first and second interspaces of the elytral declivity (fig. 45) smooth and shining while the third is very greatly elevated and armed with large, close set, blunt serrations, usually ten in number.
Type locality: California, probably Guerneville.
Distribution: Central California north into British Columbia. In Oregon it is found along the coast from Brookings at least to Coos Bay. We also have specimens taken in the Cascade Range and at Gresham, Oregon.
Habits and work: Like other species of the genus they work in pairs, preferring fire scorched, injured, weakened, dying, and recently dead trees.
The egg gallery (plate IV, G) is parallel with the grain of the wood, lies in the cambium and extends up from the usual turning niche at the base of the entrance tunnel. This turning niche is made by widening the gallery on both sides. The average number of eggs deposited appears to be about 50. Egg niches are closely placed, almost crowded against one another. A short spur is usually excavated a short distance below the far end of the tunnel. Larval mines start transversely but gradually change to a vertical direction. The pupal cells are sometimes in the cambium but more often lie almost, or completely, in the sapwood.

The adults are on the wing as early as April in northwestern California and there are probably two generations per season. Specimens were taken May 30th in the Cascades of Oregon (3,000 feet) and August 10 in southern Oregon. A considerable series emerged in the laboratory from Port-Orford-cedar in June where it was working with *P. rubicundulus* but only in small numbers.

Blackman (42:448-450) described a species *P. squamosus*. This name was preoccupied and Schedl (50:36) renamed the species *blackmani*.

After studying a considerable number of specimens of *sequoiae* and *blackmani* from redwood, western redcedar, and Port-Orford-cedar, and a study of the galleries taken in California and Oregon, it is evident that *blackmani* cannot be separated from *sequoiae* and therefore the latter becomes a synonym.

*Phloenosinus vandykei* Swaine 15:366

Only slightly larger than *hoppingi*, length 2.2 mm.; reddish-brown with a polished appearance; front of female flattened, deeply, sparsely punctured, and granulate; front of male broadly, deeply concave; pronotum wider than long (5:4); disk coarsely, deeply, sparsely punctate with fine pubescence and faint median line; elytral striae narrow and deep; interspaces convex and sparsely, coarsely, asperate-punctate.

Type locality: Huckleberry Meadow, Fresno County, California.
Distribution: Sierra Nevada Mountains of California, north into Oregon.
Host: Incense-cedar (*Libocedrus decurrens*) and western redcedar (*Thuja plicata*). Blackman reports numerous specimens from southern Oregon, Klamath Falls, and Pinehurst.
Habits and work: Quite similar to *P. hoppingi*, attacking limbs up to 3 inches in diameter. Egg tunnels are from $\frac{1}{4}$ to $\frac{1}{3}$ inches long and longitudinal. The eggs are placed in widely spaced, alternate niches and the larvae mines start at right angles but quickly turn and run with the grain of the wood.
Phloeosinus fulgens Swaine 24:147

Length 2.6 mm.; dense black with antennae and tarsi red, covered with minute almost invisible pubescence. Front of head broadly, deeply concave, closely and deeply punctured, median carina obsolete; pronotum large, wider than long, closely and moderately punctured on the disk, more densely on the sides, median line indistinct; mesosternum oblique; elytral striae impressed, the first more strongly; punctures of medium size; interspaces wider than striae, scarcely convex, coarsely and closely granulate-punctate on the disk, laterally coarsely and roughly punctured; the declivity (fig. 45 G) brightly polished with striae deeply impressed, punctures large; first and third interspaces a little more elevated than the second and each with a row of sparse, nearly obsolete serrations and numerous small punctures; second interspace flat, as wide as the others, without serrations and with indistinct punctures.

Closely related to rugosus and juniperi but the smaller, more slender form, front of head, brightly polished declivity (male) and feeble declivital serrations all serve to distinguish it.

Type locality: Northfork, California.

Distribution: Found on the west slope of the Sierras of Central California, north into Oregon. Taken at Ashland and Wonder, Oregon (Blackman 42:428).

Host: Incense-cedar (Libocedrus decurrens).

Habits and work: Attack is largely confined to the tops of small incense-cedars. The egg galleries are longitudinal, straight, from \( \frac{1}{2} \) to 1½ inches long, and almost entirely in the bark. As usual, larvae mines start at right angles to the primary tunnel but soon turn and run with the grain of the wood. They are 1½ to 3 inches long and engrave the wood quite deeply. Pupal cells are in the wood and lie parallel to both surface and grain. Examples of work in the California Academy of Sciences show that the beetles mine down from the entrance tunnel and a very distinct turning niche is placed well back from the end of the egg gallery.

Phloeosinus splendens Blackman 42:428

Black and reddish- to piceous-brown elytra; length 2.37 to 2.8 mm. Clubs of antennae twice as long as wide, all sutures oblique.

Pronotum brilliantly shining, with moderately coarse, deep, closely placed punctures (coarser and less closely placed than in fulgens to which it is very closely related).

Elytral surface shining; discal striae deep, wider than in fulgens; punctures coarse, shallow, distinct.

Declivity (fig. 45 F) brilliantly shining, striae deeply impressed with distinct punctures; first and third interspaces strongly convex, each with a few sparse, fine, obsolete granules not arranged uniseriately.

Type locality: Pinehurst, Oregon.

Distribution: Reported only from type locality.

Host: Libocedrus decurrens
The type series was bred from tops of incense-cedar by W. J. Buckhorn who noted that the insects were killing the tree. No other data are available on this species.

*Phloeosinus juniperi* Swaine 17:10

A larger species (3.0 to 3.6 mm. in length) with the carina more strongly developed; strial punctures coarser and the mesosternum oblique. The declivity (fig. 45H) is very closely punctured; interspaces 1 and 3 slightly elevated, each with a row of regular, small, acute serrations; the second slightly wider than either 1 or 3, not narrowed at tip, with 2 or 3 very small serrations near the apex; outer interspace finely serrate; fine yellow pubescence on the disk, thicker, somewhat scalelike on the declivity.

Type locality: Scaffold Meadows, Tulare County, California (collected by Ralph Hopping).

Distribution: California, Oregon, and Washington.

Common in central Oregon where juniper grows.

Host: Western juniper, *Juniperus occidentalis*.

Habits and work: This is probably the most abundant species in juniper from Klamath County north and is especially abundant in the Prineville-Redmond area, east to Lakeview.

Attacks are aimed at the main trunk and larger limbs of its host and it is found in newly set juniper fence posts and poles. It attacks living trees and has caused the death of quantities of juniper in the above area, although weakened and dying trees are preferred if available.

Rather large egg galleries extend up or down the cambium from a good sized chamber. The galleries are single, usually 2 to 3½ inches long, with egg niches fairly closely placed; instances of more than 100 eggs per gallery have been noted. Egg galleries are about half in the wood and half in the bark, with most of the pupal cells being in the wood. Attack is often in great numbers and the entire cambial area is destroyed.

*Phloeosinus chamberlini* Blackman 42:470

Medium size (length 2 to 2.50 mm.), black with dull reddish-brown elytra. Antennal club twice as long as wide, first and second sutures slightly oblique, third strongly so and sinuate. Disk of pronotum with very deep, rather close punctures; median line not elevated; pubescence short and fine, distinctly longer just anterior to the small lateral calli.

Elytral striae about half as wide as interspaces, strongly impressed, strial punctures close and shallow, smaller on the declivity; interspaces convex, granulate-asperate near base, rugose-punctate with few rounded granules in middle of disk. Declivity with first, third, and alternate interspaces rather strongly convex, first and third closely and finely punctured. Each with a uniseriate row of moderately small serrations; fifth and seventh interspaces with 2 to 4 similar serrations.
Type locality: Alturas, California. 
Distribution: California and Oregon. In juniper areas of central Oregon from
Prineville to Klamath Falls. 
Host: *Juniperus occidentalis*

The egg galleries (plate IV, F) are 1½ to 2½ inches long, vertical, and
engage the wood rather deeply. The turning niche is large and well back
from the entrance; egg niches are deep; larval tunnels engrave the wood and
are quite irregular.

An examination of 34 galleries showed a maximum of 64 egg niches, a
minimum of 19 and an average of 40.5.

**Phloeosinus rugosus** Swaine 17:9

Length 3 mm., dark brown to black. Antennal club twice as long as
wide, with oblique sutures. Pronotum black and shining, with deep, moder­
ately large, close punctures, much finer and more closely placed near front.
Elytral surface piceous-brown, striae rather narrow, and somewhat impressed,
with moderately small, shallow, indistinct punctures; interspaces rather wide
on disk, first two widened near the base, rather coarsely granulate-­punctate,
rugose on anterior third. Declivity closely, roughly punctured, striae narrow,
distinctly impressed; first and third interspaces each with a row of moderate­
sized serrations, second nearly flat, shining, and without serrations.
Type locality: Scaffold Meadows, Tulare County, California.
Distribution: California and Oregon. Keen (29:97) also gives Colorado.
No specimens of this species taken in Oregon have been seen, but Black­
man (42:468) states that there is a series in the national collection taken at
Alturas and Devils Garden, California, in *Juniperus occidentalis*. Since these
localities are only a short distance below the Oregon line and have similar
climatic conditions with the same species of juniper extending north
through Klamath County, the species undoubtedly occurs in Oregon.
Host: Western juniper, *Juniperus occidentalis*.

Specimens of the work of this species in the California Academy of
Sciences from Lassen County, California in *Juniperus occidentalis* show the
egg gallery engraving the wood for about ½ the diameter; length 1⅜ inches,
with 63 egg niches. The turning niche, somewhat back from the entrance,
is almost round, thus expanding both sides of the main gallery. Larval tunnels
average 1¼ inches in length.

**Phloeosinus scopulorum** Swaine 24:148

Length, 2.8 mm., black with piceous elytra; front of head densely gran­
ulate-punctate, with a more or less transverse median impression; pronotum
wider than long; disk closely and deeply punctate, not granulate, its surface
shining, with a narrow, distinct, elevated, median line; elytra with wide dis­
cal interspaces, feebly convex, confusedly granulate, closely punctate from
base to declivity; first and third interspaces of the declivity with rather coarse,
uniseriate, black, serrations, less numerous on the first interspace.
Type locality: Williams Lake, British Columbia, Canada.
THE SCOLYTOIDEA OF THE NORTHWEST


Host: Western juniper (Juniperus scopulorum). A series in the Hopping collection is labeled Creighton, British Columbia from Thuja plicata.

Note: This species attacks the main trunk of weakened, dying, and cut junipers. The mines are very similar to those already described for P. antennatus.

11 Genus XYLECHINUS Chapuis 73:244

This genus is essentially tropical with numerous species known from Central and South America. Blackman described the two North American species X. americanus (22:117) from Maine and X. montanus (40:123) from Montana.

DESCRIPTION OF THE GENUS

Small (2 to 3 mm. in length), quite oval, head invisible from above, pronotum regularly narrowed from base to front, 2 as long as elytra; antennal club pear-shaped with 3 distinct sutures, the basal one arcuate, other two nearly straight; funicle of 5 segments; anterior slightly widened distally. Outer margin undulate near the apical end.

There is a single species known to occur in the Northwest.

Xylechinus montanus Blackman 40:123

Small, 2.43 mm. long; brownish, with cinereous scales and hairs. Front convex, flattened between eyes; epistoma transversely impressed, with sharp median carina extending from margin to the poorly developed transverse impression. Antenna (fig. 47) with funicle of 5 segments subequal in size, club coneshaped with three prominent straight sutures, the first with a septum.

Pronotum about as long as wide, widest behind the middle, converging at posterior two-thirds, surface moderately closely punctured, feebly granulate on anterior and lateral areas, with narrow, feebly elevated median line, clothed with short, scale-like setae, directed toward median line.

Elytra distinctly wider than pronotum, about 1.7 times as long as wide; basal margins separately, strongly arcuate, strongly elevated and crenulate, with a partial second row of teeth behind the marginal row; sides nearly straight and subparallel on anterior two-thirds, very narrowly rounded be-
hind; striae strongly impressed, of moderate width, shining, with deep, very close, moderately coarse punctures; interspaces wider, but with the second and fourth slightly narrower than the others and subequal to striae, convex, finely punctate and granulate; surface shining, but mostly concealed by semi-recumbent, short, thick, cinereous setae, each interspace with a middle row of slightly longer and thicker, erect, cinereous setae, the posterior ones notably longer. Declivity arched, with interspaces 1, 3, and 9 distinctly elevated; first interspace widened, second interspace greatly narrowed; striae narrower, with punctures smaller. Abdominal sternites 1, 2, and 5 subequal and each about as long as segments 3 and 4 combined; clothed with moderately abundant, cinereous hairs, sparser on first two segments.

Anterior tibiae with a long narrow process extending from the outer apical angle and with six teeth (fig. 47).

Type locality: Sula, Montana.
Distribution: Montana to British Columbia, Oregon (Tollgate), Utah, and Colorado. North of Fort St. James, British Columbia (Fowler).

Hosts: *Picea engelmannii* and *Larix occidentalis*.

Habits and work: The species is polygamous; the entrance tunnel leads into an irregular central chamber from which 2 to 4 egg tunnels radiate with 10 to 30 eggs, each in its separate niche. Attack is usually on the main stem of small suppressed trees which are weakened, dying, or recently dead.

The fact that these insects have not been commonly collected is probably due to the type of material attacked rather than to their rarity.

12 Genus LEPERISINUS Reitter 13:41

Members of this genus are readily distinguished from species of other genera found in this territory by the host, which is always ash (*Fraxinus*), and by the scale-covered body which separates the species from all other genera except *Pseudohylesinus*.

As presently constituted, there are eight* species in the genus in North America and two of these are found in our territory. Until recently the name *Leperisinus aculeatus* (Say) has been used for our species but Blackman described *L. oregonus* (1943) from Oregon and Swaine (1916) described *L. californicus* from California where it had been collected from living olive trees.†

R. A. Underhill revised the genus‡ and shows that the two species in Oregon are *L. oregonus* and *L. californicus* while Say's species *L. aculeatus* described from Missouri, ranges west to Colorado and New Mexico. Records from further west refer to *californicus* or *oregonus*.

*In a paper published after this monograph was in the hands of the printer, Wood (57:399) placed *L. cinerus* Sw. in synonymy.
†This is the only record of species of the genus working in any tree other than *Fraxinus*.
‡Unpublished thesis, Department of Entomology OSC.
Our two species are very similar in general appearance (fig. 49) and are most easily separated by the characters of the antennae. They differ markedly in their life histories as noted below.

Key to Species of *LEPERISINUS* in the Northwest

1. Antennal club oval and compressed; two distinct sutures with a third sometimes visible ........................................... *CALIFORNICUS* Sw.

2. Antennal club elongate, conical with three distinct sutures and a fourth present but not always distinctly visible ...... *OREGONUS* Blkm.

*Leperisinus californicus* Swaine 16:190

In addition to the characters given in the key, the frons is convex with weakly developed acute median carina, numerous long, yellow, hairlike scales project from the basal corners of the epistoma; pronotum not distinctly constricted anteriorly; hairlike scales numerous on sides of the elytra. Length 2.5 mm. (fig. 49).

Type locality: San Diego County, California.


Hosts: Various species of *Fraxinus*, and described from specimens collected from living olive trees in California.

Life history: *L. californicus* usually passes the winter in the larval stage since the species is in that stage for 7 to 9 months (Willamette Valley). Adults are on the wing from July and August and egg deposition goes on until cold weather sets in. Incubation requires about two weeks, and larvae are present until the following June. Pupation occurs from April until late June and adults start to emerge from late July until mid-August. The length of the stages, and emergence dates vary somewhat with seasonal conditions, exposure, and other factors.

Galleries of *L. californicus* and *L. oregonus* are not distinguishable. Few if any species of scolytids make more uniform galleries. They appear to have been made by an expert wood engraver. The egg gallery, constructed by the female is of the biramous type (fig. 50). The short entrance tunnel extends up the tree or limb and serves as a turning niche while the two arms extend across the grain of the wood, engraving it deeply. If unobstructed, the two gallery arms are approximately the same length; Underhill* checked 40 galleries and found the maximum length to be 73 mm. and
the minimum 11 mm. Each arm usually extends 25 to 30 mm. Larval galleries average about 50 mm. in length, run with the grain of the wood, and are nearly straight. Occasionally, where attacks are on the main trunk, larval tunnels are very long; on a specimen before me they average 130 mm., the longest is 154 mm., and the pupal cells have been made in only a very few cases. They might have extended even further if undisturbed. Egg niches are deep and closely placed; the number varies from a minimum of 11 to a maximum of 133 with an average of about 50.

*Leperisinus oregonus* Blackman 43:396

Very similar to *californicus*, length 2.8 to 3.3 mm. (fig. 49 B). Most easily distinguished from the only other species in this territory by characters of the antennae as given in the key, and figure 48. Additional characters are—pronotal asperities distinctly developed and wide bands of whitish scales on the cephalic region of the pronotum.

Type locality: Forest Grove, Oregon.

Distribution: Oregon and Washington.

In Oregon the species is common in the Willamette Valley and probably will be found in various localities where ash grows. Specimens have been taken at Creswell, Eugene, Corvallis, Portland, and St. Helens. Patterson (1945) reports *Leperisinus aculeatus* (Say) from western Washington, but since that species does not occur west of the Rocky Mountains the species reported is undoubtedly either *californicus* or *oregonus* and it is probable that both are present in western Washington.

Hosts: Any species of *Fraxinus* within their range. Our specimens are from *F. latifolia*.

13 Genus *SCIERUS* LeConte 76:390

This genus is closely related to *Hylastes* and *Hylurgops*. The form is similar to the latter; differs from both by having front coxae widely separated by the prosternum. The third tarsal segment is wider than in *Hylastes* and not as deeply lobed as in *Hylurgops*. The antennal funicle is of 7 segments, club ovate, pointed, first segment smooth, shining, and subequal to the others united (fig. 14). Tibia are dilated and broadly serrate as in *Hylastes*; terminal mucro short; first, second, and fifth ventral segments subequal in length with the third and fourth shorter.

* Unpublished manuscript Oregon State College.
**Scierus annectens** Le Conte 76:390

Length, 3.6 mm. (fig. 51). Oblong-cylindrical; dark brown, thinly clothed with short, depressed, yellow hairs; head convex, front not carinate or impressed; prothorax one-third wider than long, sides rounded, narrowed in front; densely, strongly punctured, usually with a narrow dorsal line. Elytra wider than thorax, basal margin finely serrate, striae deeply impressed, punctate; narrower than interspaces, latter scabrous with transverse rugosities; third and ninth united near the tip and joined with the first.

Type locality: Anticosti Island, Gulf of St. Lawrence.

Distribution: Widely distributed. In the West fairly common in British Columbia, Waterloo; rare in Washington (Patterson); and Oregon in the Blue Mountains (Underhill); Ashland, Oregon (Sergent coll.).

Hosts: Red spruce (*Picea rubens*) (Hopkins); White spruce (*P. canadensis*), Engelmann spruce (*P. engelmannii*) (Swaine); Lodgepole pine (*Pinus contorta*) and probably Sitka spruce (*Picea sitchensis*) (Keen).

There are specimens in the Hopping collection (C.A.S.) from *Abies lasiocarpa*.

**Scierus pubescens** Swaine 24:286

Length, 4.3 mm. Similar to the last, but larger with a glistening dorsum; narrower pronotum which is coarsely and less closely punctured, with a rather convex median line. The elytra with wider striae and narrower interspaces especially narrowed on the apical half; uniserially granulate on the declivity; pubescence of interspaces yellow and longer than in *annectens*.

Type locality: Jasper Park, Alberta, Canada.

Distribution: In addition to Alberta, H. E. Richmond collected a considerable series from spruce near Vernon, British Columbia; Lorns, British Columbia (C.A.S.); Stanley Park, British Columbia (Hopping coll.); and Seattle, Washington.

Host: In the Hopping collection series (C.A.S.), the hosts indicated are *Abies lasiocarpa*, *Picea engelmannii*, and *Pinus contorta*.
The genus *Alniphagus* was separated from *Hylesinus* Fabr. by Swaine, on the following characteristics: "Of medium size, antennal funicle 7 segmented, club feebly compressed, with sutures 1 and 2 strongly sclerotized, last two segments longer than 2 and rapidly narrowed by a constriction and a row of hairs; beak short; pronotum strongly muricate on the sides in front; side pieces of the meso- and metathorax densely scaly. Forecoxae widely separated; proventriculus without distinct diagonal lines, the costal teeth numerous at the base of the bristles, its disk finely, sparsely granulate, sclerotized on the sides, the transverse lines strong; the ligula rounded at the apex."

*Alniphagus aspericollis* (LeConte) 76:379 The Alder Bark Beetle

This species was described by LeConte (1876) in the genus *Hylesinus*.

*Alniphagus aspericollis* (LeConte) 76:379 The Alder Bark Beetle

This species was described by LeConte (1876) in the genus *Hylesinus*.

Description: Cylindrical, rather elongate, blackish-brown, thinly clothed with fine, short pubescence (fig. 53). Head sparsely punctured, with faint, frontal impression, and an indistinct, smooth, median line. Prothorax at base scarcely wider than long, slightly rounded on the side, gradually narrowed in front but not constricted, nearly truncate at base and apex, finely and densely punctured, sparsely but strongly asperate, with acute tuber-
cles at the sides; side pieces of meso- and metathorax densely scaly. Elytral striae strongly impressed and coarsely punctured, interspaces moderately convex, minutely granulate-punctate and uniseriately asperate, alternate intervals wider and strongly convex on the declivity. Antennae ferruginous, with seven distinct segments in the funicle; club feebly compressed, sutures 1 and 2 strongly chitinized, last two segments longer than 2 and rapidly narrowed, segments of club indistinctly subdivided by a constriction and a row of hairs; beak short. Front tibia rather suddenly dilated at the tip. Length 3.5 to 4 mm. Type locality: Santa Barbara, California. Distribution: California, Oregon, Washington, Idaho, and British Columbia. Hosts: Red alder (Alnus rubra) and white alder (Alnus rhombifolia). Habits: The entrance tunnel is made by the female, often at the base of a branch. She is soon joined by a male; a longitudinal egg gallery, from 2 to 5 inches long, is constructed with no apparent nuptial chamber (fig. 52). Eggs are placed close together along both walls of the gallery, with as many as 50 eggs to the inch. Larvae work out at right angles from the egg gallery but soon turn and run vertically; they pupate in the soft inner bark. There appear to be two generations a year, with attacks occurring throughout the growing season. Special hibernating tunnels have been found. These consist of an irregular chamber with numerous, finger-like, short tunnels running up and down from the chamber, or short, straight galleries (fig. 11)—all in the bark, not contacting the wood. This is a common, and occasionally destructive, enemy of western alders. The beetles usually attack weakened, dying, or felled trees, but at times kill both young and old healthy trees.

Alniphagus hirsutus Schedl 49:236

Reddish- to dark brown, length 2.5 to 3.2 mm. Smaller and stouter than A. aspericollis, more narrowly rounded apex of the pronotum, comparatively broadly curved apical margin of the elytra, inconspicuous granules on the alternate interstices and longer vestiture of the whole beetle; elytral striae not deep, punctures smaller, inclined ground scales on all interstices much longer, especially on the declivity. Type locality: Copper Mountain, British Columbia. Host: Alnus sitchensis—Alnus sinuata.

This species has not been reported from any other locality. It is very closely related to A. aspericollis and the habits are probably similar.

G. Stace Smith kindly loaned four topotypes and although the characters as set forth by Schedl are not striking, direct comparison reveals the difference. We are unable to note that the elytra are any wider at the start of the declivity than they are near the base, and size is not a criterion, except that hirsutus is generally smaller. In a series of aspericollis from Vancouver Island, British Columbia a number of specimens are as small, or smaller, than the specimens we have seen of hirsutus. Perhaps the most evident character for separating the species is the almost total absence of interstrial granules when compared with aspericollis.
15 Genus HYLASTINUS Bedel 88:388

There is no native species of this genus found in the United States. The genus is closely related to Alniphagus, Hylastes, and Hylesinus. It is represented in this area by the well-known, introduced, clover root borer \textit{H. obscurus} which was described in the genus \textit{Ips}.

\textit{Hylastinus obscurus} (Marsham) 02:57

\textit{H. trifolii} (Mueller) is a synonym.

Length 2.5 mm.; black to dark brown; pronotum coarsely, closely punctured, elytral striae deep, coarsely, closely, shallowly punctate; interspaces rugose; meso- and metasternal side pieces densely covered with yellow fringed scales. Antennae with first suture distinct, strongly chitinized. Type locality: Probably central Europe.

Distribution: Widely distributed in the old world and occurs in practically every state in the United States and all southern provinces of Canada.

Hosts: Occurs in a wide variety of legumes, including most varieties of clover, alfalfa, and peas, rare in Scotch broom (\textit{Cytisus scoparius}) in Oregon; beans, vetch, and in Russel lupin in Portland, 1954 (new host).

Habits and work: Winter is passed largely as adults in the old root tunnels. Adults emerge in the spring and excavate new egg tunnels in the host's root running with the fiber, or horizontally, and only a few eggs (4 to 9) are deposited. On rare occasions two females will be found in one gallery with double the normal number of eggs. Many females excavate a second, third, or even a fourth egg tunnel although less eggs may be deposited in these later tunnels. Egg galleries vary in length from less than 1 to about 1\frac{1}{2} inches. The eggs are placed in niches and the latter sealed off.

Rockwood (1926) credits Cordley as reporting the species in Oregon in 1896. Riley reported it in New York in 1878 and it doubtless had been present in this country for some years. It is reported to be one of the factors limiting the life of red clover and is a severe pest of other clovers and alfalfas.

16 Genus PSEUDOHYLESINUS Swaine 17:11

The reader is referred to Blackman's "Revision of the Bark Beetles Belonging to the Genus \textit{Pseudohylesinus} Swaine," for long complicated descriptions of the various species. That author had several thousand specimens for study and found separation based on morphological characters extremely difficult, requiring the use of characters not usually employed to separate closely related species.

Host trees are of less value here than in most genera since several species of \textit{Abies} serve as hosts for five different species, and six species are reported to attack \textit{Tsuga heterophylla}.

Distribution is of little use since a specific locality may harbor many species.

* This date should be 1895.
In some cases the galleries are valuable in helping to correctly identify species. Unfortunately, detailed information on the mines of some species has not been noted or at least has not been published.

As suggested with the genus *Phloeosinus*, all collectors should make a special effort to secure specimens of the species' work when they are collecting so that insect and work may be correlated.

After studying the available material in this genus the writer is not convinced that all species mentioned are valid. The biology and work of each needs much study to establish the status of some so-called species.

All but two of the species known from the United States are found in the Northwest, hence Blackman's key is reproduced herein and his figures 1 and 2 are also reproduced since it is impossible to interpret the descriptions without them.

**DESCRIPTION OF THE GENUS:** Body oval, elytra densely covered with scales; front coxae narrowly separated; elytral bases strongly arcuate, slightly elevated and regularly serrulate; venter of the abdomen somewhat oblique; ventral segments 1, 2, and 5 subequal in length. The scaly elytra, oval shape, and dull, often variegated appearance will serve to distinguish the species from other bark beetles in the same hosts.

There are 16 species recognized by Blackman as belonging to this genus. All are western in their distributions and all breed in coniferous trees. *Abies*, *Pseudotsuga*, and *Tsuga* are the principal hosts although two species of *Pinus* and one *Picea* also serve as host trees.

All but 3 of the 16* described species have been reported from the Northwest and 1 of these 3, *maculosus*, may occur in southern Idaho since it ranges into Utah. About 6 of these can be considered primary pests, at times attacking what appear to be perfectly healthy trees. The balance of the species are largely secondary, breeding in recently cut trees, wind throws; trees weakened by fire, storm, or other insects; or in dying parts of living trees. All tree parts are subject to attack by the various species. Some prefer the tops, others the branches, a few attack the main trunk, and at least one species attacks near the ground and often works into the roots.

The species are difficult to separate; however, the genus as a whole can be separated from other genera working in coniferous trees by the presence of numerous elytral scales.

**Blackman's Key to Species of PSEUDOHOLESINUS Swaine**

1. Body more than 2.4 times as long as wide; antennal club with first segment a little longer than second, but never so long as second and third together; frontal rectangle in females slightly wider than long

2. Body less than 2.3 times as long as wide except in *granulatus* (Lec.); antennal club with first segment much longer than others, sometimes as long as or longer than segments 2 and 3 together; frontal rectangle in both sexes longer than wide

*One of these, *P. mexicanus* Blkm., has not been found north of Mexico.
2. Basal margins of elytra with serrations at sides higher, sharper, and more widely spaced than near center; ninth interspace strongly elevated behind, with high, acute serrations at sides of declivity; disk of elytra with granules of interspaces very small and setae short, fine, and inconspicuous; frontal rectangle distinctly wider than long in female .......................................................... 3

Basal margins of elytra with serrations at sides not notably higher and sharper; ninth interspace not strongly elevated behind, with serrations only moderately high and acute; setae of elytral interspaces stout except in pullatus, n. sp., moderately short to moderately long; frontal rectangle of female slightly wider than long ................................................................................................................. 4

3. Smaller (2.4 to 3.14 mm. long); elytra with setae short and rather inconspicuous; scales of elytral disk slender and acuminate behind in females, subcircular in males; declivity with interspaces 1 and 3 weakly convex, with asperities no stronger than on disk; second interspace slightly narrowed posteriorly .......... NEBULOSUS (Lec.)

![Fig. 54. Frontal aspects of Pseudohylesinus, Blackman's figure 1 A, illustrates the frontal rectangle; B, nebulosus ?; C, nebulosus ?; D, pullatus ?; E, pullatus ?; F, granulatus ?; G, granulatus ?]. All drawings to the same scale.
Larger (3 to 3.5 mm. long); elytra with setae very short and fine, very inconspicuous, scales of elytral disk subcircular in both sexes; declivity with interspaces 1 and 3 strongly convex, with asperities much coarser than on disk; second interspace greatly narrowed, almost or quite obsolete posteriorly ..........  

SERRATUS Bruck

4. Setae on pronotum and elytra short and fine, those on elytral declivity not so long as width of an interspace ................................................................. 5

Setae on pronotum and elytra much larger and coarser, those on elytral declivity longer than width of an interspace ............................................................... 6

5. Color pattern of dark brown scales and cinereous scales, the brown ones greatly predominating in both sexes; anterior margin of pronotum broadly rounded, submarginate, pronotal scales broad, with ends divided and tuftlike in female; elytra moderately narrowly rounded behind; setae shorter and rather fine, scales oval in both sexes, slightly broader in male .......... PULLATUS Blkm.

Color pattern of light brown scales and cinereous scales, the light ones predominating in males at least; anterior margin of pronotum very broadly rounded, pronotal scales rather narrow in female, with ends fimbriated; elytra more narrowly rounded behind, setae slightly longer and stouter, scales broader, subcircular in both sexes ......................... DISPAR Blkm.

6. Pronotum of female with scales divided to bases, appearing hairlike; elytra rather narrowly rounded behind, scales on disk about twice as long as wide with free ends subacuminate .......... MACULOSUS Blkm.

Pronotum of female with pronotal scales wide, rather short, with free ends often fimbriated; elytra moderately rounded behind, scales on disk subcircular .................. MEXICANUS Blkm.

7. Body about 2.37 times as long as wide; large (up to 5.5 mm. long); antennal club not appreciably flattened; frons and pronotum strongly granulate-punctate .......... GRANULATUS Lec.

Body not more than 2.25 times as long as wide; smaller (less than 4.6 mm. long); antennal club appreciably flattened; frons and pronotal surfaces not strongly granulate, at least in females ................................................................. 8

8. Scales on pronotal disk narrow and hairlike, at least in females; elytral striae wider, interspaces appearing convex; setae smaller and usually inconspicuous in females, shorter than width of interspaces ........................................ 9

Pronotum scales broader, not hairlike in either sex; elytral striae appearing narrow and interspaces flat; setae coarser, longer, conspicuous, as long as, or longer than, width of interspace in both sexes ................................................................. 10

9. Body at least 2.2 times as long as wide; frons somewhat tumescent below arcuate transverse impression; scales on pronotal disk of males varying from hairlike to slender, broader toward sides; elytral scales of females narrow, often hairlike on disk, broader on declivity .......... PULPINUS Blkm.

Body less than 2.2 times as long as wide; frons somewhat flattened below arcuate transverse impression; pronotal scales of males broad, none of them hairlike; elytral scales of both sexes broad; less than twice as long as wide .... 11

10. Body larger (up to 4.5 mm. long); pronotum brightly shining, not roughly punctate-granulate; scales of male pronotal disk hairlike in median third, broader at sides and behind ................................................................. 12

Body less than 4.5 mm. long; pronotum moderately shiny, roughly punctate-granulate; scales of male pronotal disk hairlike only in anterior median sixth, broader on rest of disk ................................................................. 13

11. Pronotal vestiture moderately abundant, very slender, hairlike, not short; elytral striae half as wide as interspaces, with punctures close and of moderate size; interspaces wide, moderately convex; asperities often irregular or confused on anterior half of interspaces 2, 3, and 5 ....... TSUGAE Sw.
Pronotal vestiture abundant, short, slender; elytral striae very narrow, faintly impressed on disk, with punctures small, very close; interspaces very wide, faintly convex; asperities irregular or confused on interspaces 3 and 5..............OBESUS Sw.

12. Body about 4 mm. or more long; ratio of frontal rectangle 1.14 in female, 1.2 in male; distinctly granulate above in male; pronotum with sides subparallel behind, abruptly constricted anteriorly in females; elytral striae much narrower than interspaces on disk, rather deeply impressed; asperities somewhat confused on interspaces 2 to 5 ..........................................................KEENI Blkm.

Body little more than 3 mm. long, ratio of frontal rectangle 1.02 in female, 1.13 in male; not granulate above in male; pronotum with sides broadly arcuate behind, gradually constricted anteriorly in females; elytral striae nearly as wide as interspaces on disk, less deeply impressed; asperities uniseriate throughout except at extreme bases of interspaces ........................................SIMILIS Blkm.

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Fig. 55. Frontal aspects of Pseudohylesinus, Blackman's figure 2 A, tsugae ♂ ; B, tsugae ♀ ; C, keeni ♂ ; D, keeni ♀ ; E, grandis ♂ ; F, grandis ♀ ; G, nobilis ♂ ; H, nobilis ♀ ; I, sericeus ♂ ; J, sericeus ♀ . All drawings to the same scale. K, antennae of P. nebulosus; L, P. granulatus and M. P. grandis.
13. Pronotum widest just behind middle, sides strongly arcuate, surface bright and shining, smooth, pronotal vestiture in male of small, broad scales not concealing surface; elytral striae nearly as wide as interspaces, punctures moderately coarse and deep, very close; asperities of interspaces uniseriate throughout, scales very small, not concealing surface .............................................. NOBILIS Sw.

Pronotum widest near base, sides weakly, convergently arcuate, surface shining, more roughly punctured, pronotal vestiture in male of large, broad, light-colored scales nearly concealing surface; elytral striae not quite so wide, more shallow, punctures moderately coarse, not so deep or close; asperities of interspaces somewhat confused on anterior third, scales large and wide, concealing surface except asperities .............................................. FURNISSI Blkm.

14. Frontal rectangle in females about 1.02 times, in males about 1.17 times, as long as wide; arcuate, transverse impression in female not deep, indistinct, with surface below tumescent; pronotal scales of males about twice as long as wide; scales of elytral disk of females dense, subcircular except on sutural interspaces .................................................. GRANDIS Sw.

Frontal rectangle in females more than 1.12 times, in males more than 1.3 times, as long as wide; arcuate transverse impression in females deep and distinct, with surface below it somewhat tumescent; pronotal scales in males subcircular; scales of elytral disk of females distinctly longer than wide throughout. 15

15. Slightly larger (from 2.5 to 3.4 mm. long); pronotum of female widest near base, sides subparallel on posterior half; elytral scales of female more than twice as long as wide, with their posterior ends narrow to subacuminate, distinctly longer than wide on declivity .............................................. SITCHENSIS Sw.

Slightly smaller (from 2.57 to 3.28 mm. long); pronotum of female widest in front of base, sides distinctly arcuate on posterior two-thirds; elytral scales of female less than twice as long as wide and more broadly rounded behind, subcircular on declivity .............................................. SERICEUS Mann.

**Pseudohylesinus nebulosus** (LeConte) 59:285

Described as *Hylesinus nebulosus*. Hamilton (94-345) refers to it as a variety of *H. sericeus*.

Body quite slender, 2.8 to 3 mm. long; grayish to yellowish-brown, variegated markings; outer interspaces of the elytra marked with rows of small acute tubercles; prothorax rounded; elytra marked confusedly with scales. The antennal club subovate, pointed, and twice as long as wide with straight sutures (fig. 56). Male densely clothed with stout scales. Female with ninth interspace on the declivity less strongly serrate and the elytral scales elongate, becoming plumose toward the tip. Distinctly smaller than our other species.

Type locality: California.

Distribution: Along the Pacific Coast from British Columbia to Southern California, east into the Rocky Mountains.

Hosts: The common host is Douglas-fir (*Pseudotsuga menziesii*) and Blackman (1942) reports specimens in the National Museum which were bred from *Abies concolor* and *A. grandis*.  

Fig. 56. Antenna of *Pseudohylesinus nebulosus*
In Oregon it occurs in all parts of the state where Douglas-fir is found. It is common, and often destructive, in the Willamette Valley where it attacks and kills the tops of Douglas-fir. Such attack is often followed by the entrance of Douglas-fir beetles into the main trunk, causing the tree’s death. Trees in the farm woodlot suffer severely from this species.

Work: The species are monogamous. Their egg galleries (fig. 57) show some variation, typically consisting of a single, nearly straight groove about ½ inch long (½ to 1 inch) that runs with the grain of the wood, which is barely engraved. An occasional mine is definitely Y shaped (fig. 57). Larval mines are largely in the bark. The number of eggs deposited ranges from 15 to 30, or occasionally a few more; when attack is heavy, as is often the case, many larva fail to reach maturity due to the destruction of practically all available cambial tissue. Attack is confined to thin bark, hence the mines are usually found in the tops or in the branches of the host. Pupal cells are in the bark.

Pseudohylesinus dispar Blackman 42:11
Type locality: Vernonia, Oregon.
Distribution: Washington, Oregon, California, Idaho, and British Columbia (Stace Smith).
Host: *Abies concolor*, *A. magnifica*, and *A. grandis*.

Oregon localities: Vernonia (Whiteside), Crater Lake (Buckhorn), and Pinehurst (Keen). Washington: Port Angeles and Port Williams.

According to Blackman (1942) the species is found in felled or decadent trees or in trees previously attacked by other insects. Its hosts are often large trees, 2 feet or more in diameter, with bark of considerable thickness. The mines are probably very similar to those of *P. grandis* being transverse and usually branched.

*Pseudohylesinus granulatus* (LeConte) 68:175.

This species was described as a species of *Hylastes* and later LeConte (76:390) placed it in the genus *Hylurgops*. Hopkins mentions it as a *Hylesinus* where it remained until Swaine (17:11) described a new genus *Pseudohylesinus* to include this and other species.

Description: A large species, measuring from 5 to 6.5 mm. in length and 2.5 to 3 mm. in width; color very dark, deep red, almost black; pronotum narrower than elytra, slightly longer than wide, densely punctured, sides rounded, sharply constricted in front. Elytra very rough; striae prominent, the whole surface sparsely clothed with short, heavy, yellowish hairs, easily distinguished by its large size and roughened appearance.

Type locality: Oregon.

Distribution: British Columbia to California extending inland to the mountains of Eastern Oregon and Washington.

Hosts: *Abies grandis*, *A. magnifica*, *A. amabilis*, *A. concolor*, *Pseudotsuga menziesii*, *Tsuga heterophylla*, and *Pinus ponderosa*.

Habits: This species is monogamous. The attack is made in pairs and a short transverse gallery is excavated in the cambium of the main trunk (*Abies*), or in large limbs (*Pseudotsuga*) of healthy, injured, weakened, dying, or recently dead trees.

From 18 to 26 eggs are deposited in alternate niches along the egg gallery. In 5 to 6 days the eggs hatch and the larvae excavate medium long, irregular, longitudinal galleries in the cambium. The majority of the pupal cells lie entirely in the bark though a few may be found in the cambium.

It usually breeds at or near the base of large trees, the mines often extending into the roots for as much as two feet below ground. Windthrown trees with some roots remaining in the soil to maintain life, are favored as injured host plants.
Pseudohylesinus grandis Swaine 17:13

A stout, more oval species (length 3.5 mm.); densely clothed with brown and gray scales; pronotum distinctly narrower than the elytra, sides slightly arcuate, front margin rounded; disk roughly, not coarsely punctured; punctures shallow and irregular. Elytra strongly rounded at the base; striae narrow, faintly impressed on the disk, more strongly at the sides; inter­spaces wide, faintly convex, more strongly so on the de­clivity (fig. 58).

Type locality: British Colum­bia.

Distribution: British Columbia to California, east to Idaho and Colorado.


Life and seasonal history: Adults appear in the Willam­ette Valley early in April, and immediately start excavating primary galleries. The egg gal­lery is 2 to 3 inches long and typically biramous (fig. 58). The female deposits her eggs in niches along each side with about 75 eggs deposited by each female. The work of ex­cavating the main gallery is accomplished by both male and female, the latter performing the major part of the work. From 10 to 15 days are required for the eggs to hatch. The minute white legless larvae begin tunneling at right angles to the main gallery, up or down the trunk or limb running parallel with the grain of the wood. The small oval pupal cell will be found wholly in the bark at the end of each larval mine. About six weeks after the eggs are laid, the adults
are ready to emerge, eating their way through the bark from the pupal cell. In this region (Willamette Valley) adults emerging in June reattack the same tree or move to a new host and rear a second brood, which is matured by the middle of September. The adults of this second brood pass the winter in the mines, in bark crevices, or under debris of the forest floor.

This species is occasionally quite injurious to both grand fir and Douglas-fir with the latter being attacked more often in the dryer parts of its range in eastern Oregon, Idaho, etc. There is an epidemic infestation in progress in *Abies lasiocarpa* in Washington state (1953-57).

*Pseudohylesinus tsugae* Swaine 17:11

A reddish-brown, stout species, moderately clothed with short, stout hairs, has tufted hairs on the sides and narrow scales on the declivity. It is very close to *nobilis* but the striae are distinctly narrower than the interspaces; the elytral scales are very noticeably elongate. Differs from *granulatus* by being much stouter in form, with a less dense and less strongly roughed pronotum as well as by the tufted vestiture laterally. Length 3.5 to 4.5 mm. If our determinations are correct this is the only species showing a definite medium carina from base to front of the pronotum.

Type locality: Stanley Park, Vancouver, British Columbia.

Distribution: British Columbia to California. Specimens have been seen from Glacier and Naselle, Washington; Astoria and Otis, Oregon.

Host: Western hemlock (*Tsuga heterophylla*) and rarely in *Abies amabilis*.

Notes: Swaine reports that this species infests dead and dying trees, and slash, and at times attacks and kills living trees. Specimens were collected from recently cut hemlock at Astoria, Oregon, and in the Mount Rainier area of Washington. The transverse egg galleries (fig. 59) are found under the bark.

*Pseudohylesinus nobilis* Swaine 17:12

Length 3.9 mm., closely allied to *P. grandis*. Female coarsely punctured, deeply striate, stouter than *grandis*, with scales almost obsolete on the pronotum and very small on
the elytra. Front of head (fig. 55 G and H) very coarsely, sparsely punctured on the disk, finely and densely on vertex, close on beak. Antennal club as in \textit{grandis}. Strial punctures of the elytra coarse, smaller at sides; interspaces strongly convex, rather strongly uniseriately asperate.

Type locality: Santiam National Forest (now Cascade National Forest), Linn County, Oregon.

Distribution: We have taken this species in the central portion of the Cascade Mountains of Oregon and at one locality in the Coast Range of Benton County, Oregon. Patterson gives Mount Rainier and White River, Washington.

Host: Noble fir \textit{Abies procera}, and we have a single specimen taken from the cambium of \textit{Abies amabilis}, also reported from \textit{Tsuga heterophylla}.

It is apparently a rare species but should be found throughout the range of its host trees. Blackman reports this species as killing normal \textit{A. amabilis} in Rainier Park, Washington.

It breeds in dying trees but specimens have also been taken from normal healthy trees.

Character of galleries: This species was found entering the thick, flinty bark near the base of large, living, noble fir. Excavates short, transverse, two-branched, almost straight egg galleries (fig. 60), one branch being 1 cm. and the other 3 cm. in length. Its width is 2 to 3 mm. The egg galleries score the bark and the sapwood, and the nuptial chamber is in the bark. Eggs are deposited on both sides of the galleries. The larvae work out at more or less right angles and run parallel to the grain. Larval mines vary from 2.4 to 4.6 cm. in length with pupal cells formed at the end of the mines.

\textit{Pseudohylesinus sitchensis} Swaine 17:12

According to Swaine, “This species is barely distinct from \textit{grandis}. The size and shape are practically the same, slightly more slender; the front rather coarsely and closely punctured, not so densely as in \textit{grandis}; the transverse impression deeper than usual.

“The pronotum is wider than long, 13:10; the sides strongly arcuate on the caudal two-thirds, strongly constricted in front of the middle; broadly rounded on the front margin; the median carina nearly obsolete; the punctuation small, dense and finely granulate, with larger setose punctures intermixed, more numerous on the sides; the pubescence on the disc of intermixed clavate setae and palmate or tufted scales on the sides; sparsely, finely asperate on the sides.
“The elytra are one-half longer than wide, slightly narrower than in grandis; the striae narrow, with small, close punctures, moderately impressed; the interspaces wide, moderately convex, finely uniserially asperate and setose as usual, rather irregularly towards the base; the scales less dense than in grandis, and elongate, becoming tufted behind the scutellum and notably so on the sides; the marking of grandis type, but more regular, an elongate whitish mark behind the scutellum, followed by a dark and then by a light-colored elongate V-shaped marking, with the caudal third mottled in sections of the interspaces.

“This species appears to be distinct from grandis, particularly in the elongate scales and the different shape of the pronotum.

“Our specimens are few in number; probably the species is rare. The type is a male; the female has the pronotum less strongly constricted in front.”

Type locality: Menzies Bay, British Columbia.
Distribution: British Columbia to California.
Host: Sitka Spruce Picea sitchensis; Blackman reports one lot from Pinus.
Taken at Astoria (WJC), Cannon Beach (Wilford), Seaside and Otis.
The egg gallery is short and runs with the grain of the wood, entirely different from that of P. grandis.

_Pseudohylesinus obesus_ Swaine 17:15

A fairly large species (length 4.5 mm.) quite stout, gradually wider towards the posterior. Head shining and finely, moderately punctate; beak long and deeply impressed on each side. Pronotum bisinuate behind, suddenly and strongly constricted in front; disk with dense, shallow punctures, intermixed large and small, somewhat granulate, sparsely asperate at sides.

Elytra widest behind the middle; striae narrow and faintly impressed on the disk, more distinct on the sides; punctures small and close; interspaces wide, convex, minutely, not roughly punctate; pubescence short, dense, and in the form of stout hairs on the disk, tufted on the sides, elongate scales on the declivity.

Type locality: Inverness, British Columbia. Not reported from any other locality.

Host: Unknown.
This species is unknown to the writer.

_Pseudohylesinus sericeus_ (Mannerheim) 43:296

This species was described as a _Hylurgus._

This adult is rust colored, decidedly more narrow and elongate; the elytral hairs are longer than in _grandis_ to which it is closely related. Length 3 mm.

Regarding this species, Swaine (18:76) says:

“More slender than _grandis_; with longer hairs; the pronotum of the male transverse, almost oval, the frontal lobe of the pronotum less distinct; the basal teeth of the elytra are isolated and acute; but the antennal club
has the first segment distinctly longer than the second. It is in the series, *nebulosus, sericus, sitchensis, grandis*.

Type locality: Sitka, Alaska.

Distribution: Alaska and California, along the coast.

Host: Lodgepole pine, *Pinus contorta*, reported from *P. radiata* in California.

The egg galleries are short and longitudinal, extending from an entrance burrow and small side cavity in living bark of injured, dying, and recently felled shore pine.

*Pseudohylesinus similis* Blackman 42:18

Length 3 mm. Disk of pronotum with slightly elevated median line, finely, densely, and deeply punctured giving a roughened appearance.

Type locality: Paradise Valley, Mount Rainier National Park, Washington.

Distribution: Washington, Oregon, and British Columbia.

Hosts: *Abies lasiocarpa*, *A. amabilis*, and *Tsuga heterophylla*.

Oregon distribution: Blackman states that one lot was taken on the Oregon National Forest from *Tsuga* by J. C. Evenden. The name Oregon National Forest was long ago abandoned and is now a part of the Mount Hood Forest.

Specimens in the Stace Smith collection were taken in British Columbia.

Washington localities are Kent and Mount Rainier.

We have no biological data on this species other than the host trees.

*Pseudohylesinus furnissi* Blackman 42:21

Closely allied to *grandis* and *nobilis*. Length 3 to 4.10 mm.

Type locality: Mount Rainier National Park, Washington.

Distribution: Washington and Oregon. Blackman gives Olympic National Forest, Oregon. The Olympic National Forest is in Washington so the occurrence of the species in Oregon is yet to be established.

Hosts: *Abies amabilis* (Furniss), *A. grandis* (Beal).

Other than the fact that two lots were taken in windthrown trees, nothing is known of the biology of this species.

*Pseudohylesinus pullatus* Blackman 42:10

Distinguished by the color markings which differ from all other species. The elytral scales are mostly dark brown; lighter scales form only a few small light spots. In the case of the females these few spots are composed of 5 to 8 cinereous scales. Length, 2.85 to 4.28 mm.

From the very limited data available, the species seems to work under the thin bark of small noble fir and has been taken only in Mount Rainier National Park. It is 1 of 2 known species which attacks *Abies procera* and from our experience the other species *P. nobilis* works in larger trees. Keen and Buckhorn report the species killing small noble fir trees 4 inches in diameter.

Type locality: Mount Rainier National Park, Washington.

Distribution: Not reported from elsewhere.

Host: *Abies procera*
**THE SCOLYTOIDEA OF THE NORTHWEST**

*Pseudohylesinus keeni* Blackman 42:17

Very similar to *tsugae* but the light colored scales dominate the color pattern. Length 3 to 4.75 mm.

**Type locality:** Cannon Beach, Oregon.

**Distribution:** Bratton and Cannon Beach, Oregon.

**Host:** *Tsuga heterophylla*.

The type series was collected on April 11, 1935, by Keen and Furniss as the beetles were entering the limbs and upper trunk of a windthrown hemlock. No other data on the species are available.

17 Genus *HYLASTES* Erichson 36:47

This genus is represented in practically all North American localities where coniferous trees are found. The twenty-one species are of little economic importance since they prefer to attack stumps, roots, dying or dead trees or logs, particularly lower portions of such logs where there is considerable moisture. Along the coast they may be found in great numbers in fallen spruce where the cambium is often completely eaten away. Adults are attracted to stumps and are often found imbedded in the fresh pitch. They also are attracted to yards where freshly sawn lumber is piled.

Seven species have been taken in the Northwest.

**Key to Species of *HYLASTES* in the Northwest**

1. Beak with distinct median carina; male with last sternite grooved; frontal rectangle longer than wide; pronotum widest at or near the middle .......................... 2

Beak without median carina; male with last sternite not impressed; pronotum widest in front of middle. Color piceous to black when mature; slender hairy species less than 3.0 mm. long ...................................................... MINUTUS Blkm.

2. Body less than 3 times as long as wide; pronotum widest at or near the middle; elytral interspaces weakly or only moderately convex; black or piceous ............... 3

Body more than 3 times as long as wide; pronotum widest in front of middle; elytral interspaces wider than striae; ninth interspace strongly elevated behind; color reddish .......................................................... RUBER Sw.

3. Elytral interspaces convex on disk; ninth interspace quite strongly elevated behind; pronotum slightly narrower than elytra, punctures coarse, moderately close. Frons with median carina confined to the epistoma and poorly developed; sculpture coarse; striae as wide or wider than interspaces .......... NIGRINUS Mann.

Elytral interspaces moderately convex on disk; ninth interspace weakly elevated behind; pronotum widest in front of middle; species large .................................................. 4

4. Body 5 to 6.5 mm. long; pronotum with narrow, elevated, median line; first elytral striae notably deeper and wider than others ................................ MACER Lec.

Body less than 4.5 mm. long; pronotal line narrow and scarcely elevated or lacking; first elytral striae not evidently deeper and wider than others .......................... 5

5. Pronotum 1.19 as long as wide; slightly narrower than elytra. Elytral interspaces equal to striae in width, convex, finely rugose-granulate; strial punctures moderate in size, circular; pubescence scanty on disk, abundant on declivity ... GRACILIS Lec.

Pronotum slender, 1.28 times as long as wide, much narrower than elytra, punctures very coarse, close; elytral interspaces narrower than striae on disk, nearly flat, finely granulate; strial punctures very coarse, elongate quadrate; pubescence abundant on disk, longer and more conspicuous on declivity LONGICOLLIS Sw.
Hylastes gracilis Le Conte 68:174

Elongate (length about 4 mm.), blackish species with elytra more brownish; antennal club clothed with very short yellowish pubescence; head densely but not coarsely punctate; prothorax coarsely punctured with indistinct smooth dorsal line; pronotum longer than wide, sides nearly straight, apex broadly rounded, base feebly so; elytral striae with large quadrate punctures; interspaces narrow, sparsely punctate and rugose.

Allied to logicolitis but the pronotum is wider, striae punctures finer and less distinctly hairy. Much more narrow than nigrinus.

Type locality: Tahoe Valley, California.

Distribution: Widely distributed and found in all areas covered in this report.

Hosts: Abies concolor, Pinus lambertiana, and P. ponderosa. Blackman also gives Pinus edulis.

Hylastes longicollis Swaine 18:79

Length 3.9 mm.; narrow; head coarsely granulate, punctate, and covered with long hairs; beak widened at the tip; transverse carina well-developed; pronotum quite narrow, a little longer than wide and much narrower than the elytra; front margin rounded, posterior margin nearly straight; disk coarsely and densely punctured and only very slightly roughened with a well-developed median carina; elytra strongly narrowed posteriorly; striae moderately impressed with close, deep, quadrate punctures; interspaces narrower than the striae on the disk but wider on the sides; finely, densely, granulate-punctate, more coarsely on the declivity.

Closely related to gracilis, but has a much narrower pronotum, coarser striae punctures, and is more distinctly hairy.

The species is widely distributed but is not common.

Type locality: Atlanta, Idaho.

Distribution: Oregon, Washington, Idaho, and British Columbia as well as California and east into the Black Hills of Dakota.

Hosts: Specimens in the Hopping collection (C.A.S.) are labeled Abies lariscarpa and Pinus contorta.

Hylastes nigrinus (Mannerheim) 52:356 The Red Fir Root Borer

Described by Mannerheim as Hylurgus nigrinus.

H. yukonis Fall (26.207) is a synonym.

An elongate (4 to 5.5 mm.), slender, dull to shining black species with a prominent, carinate beak. Pronotum with sides nearly parallel on the caudal half (or three-quarters) and broadly rounded at the hind angles, strongly narrowed in front, rather densely punctured; elytra glabrous; interspaces slightly convex, coarsely granulate; striae wider than interspaces. The last ventral abdominal segment of the male more broadly rounded with a broad median caudal impression densely punctured and pubescent.

Type locality: Alaska.

Distribution: Alaska and Yukon Territory to California and east into the Rocky Mountains. Generally distributed over the entire Northwest.
Host: Douglas-fir. It is also reported from Pinus monticola and Tsuga heterophylla Swaine (18:79). Blackman (41:13) gives Abies and Picea. This species is not common. The larvae excavate long winding mines in the bark of the roots of Douglas-fir. Dying trees and roots of stumps seem to be preferred, though living trees are attacked. The attack is confined wholly to the base and roots so far as the writer is aware. Owing to the scarcity of the beetle it is of little economic importance.

It has been found hibernating under the moss in the cracks and crevices of oak trees growing in the vicinity of Douglas-fir stands in the Willamette Valley, Oregon.

Hylastes macer Le Conte 76:175

Rather large, length 6 mm., elongate, black; head with transverse impression arculate and finely carinate; densely and finely punctate. Prothorax one-half longer than wide; deeply and coarsely punctured on the disk; punctures smaller and more dense at the sides; dorsal line narrow and but slightly elevated; elytral striae narrow, with rows of quadrate punctures; intervals wider than striae, thickly punctured and somewhat rugose. Male with the last ventral segment impressed and pubescent.

Type locality: California.

Distribution: British Columbia to California eastward into the Rocky Mountain states. Le Conte reports it as taken by Ulke in Nebraska.

Host: Picea engelmannii, Pinus ponderosa, P. jeffreyi, and P. lambertiana.

Hylastes ruber Swaine 15:368

Adult (fig. 61) stouter than usual, the pronotum shorter and nearly as wide as the elytra; the elytra with the striae hardly impressed, narrow, the strial punctures small, the interspaces flat, and densely, rather coarsely granulate; length 4.8 mm.; width 1.75 mm.

Front strongly convex, closely, rather rugosely punctured; the pubescence minute (almost obsolete), pronotum slightly longer than wide; broadly rounded behind; hind angles rounded; slightly arcuate on the sides, subparallel for three-fourths the length, then strongly narrowed; the front margin moderately rounded; narrower than the elytra, punctures small, close, somewhat rugose. Elytra twice as wide as long, a little wider than the pronotum; the striae narrow and finely impressed, punctures small (as on the pronotum), closely placed, deep bordered with black; pubescence minute, reddish a little more apparent than on the pronotum.

Type locality: British Columbia.

Host: Dying and weakened Douglas-fir.

*Hylastes subopacus* Blackman 41:9

Length 4.6 mm.; piceous-brown almost black. Frons moderately wide between the eyes; epistomal lobe broad and short, emarginate at the middle.

Antennae with first segment of club nearly equal to the others combined. Pronotum narrower than elytra, slightly longer than wide; sides evenly, strongly arcuate, not constricted anteriorly, surface subopaque with fine, close, shallow punctures, smaller and shallower than in *nigrinus*, to which it is related, median line feebly elevated on posterior two-thirds.

Elytra with sides parallel and nearly straight for two-thirds the length, then gradually narrowed to a broadly rounded apex; striae strongly impressed with deep, close, moderately coarse punctures, smaller on the declivity; interspaces wider than striae, convex, densely granulate-punctate; ninth interspace moderately convex behind but not as strongly as in *nigrinus*; pubescence of short, fine hairs on the disk, more abundant and scalelike on the declivity; more abundant than in *nigrinus*.

Type locality: Capitan Mountains, New Mexico.

Distribution: New Mexico to Idaho.

Wood (in correspondence) states he has taken this species in southern Idaho.

*Hylastes minutus* Blackman 41:25

A small, reddish-brown species 2.6 mm. long. Frons very wide between the eyes. Frontal rectangle almost as long as wide; epistoma broadly and moderately deeply impressed. Not carinate in median line; epistomal margin thickened and liplike. Antennae with first segment of club longer than other three combined.

Pronotum slightly longer than wide, sides nearly straight, widest point just in front of middle; surface with punctures on disk, smaller and more dense in front; median line moderately wide and distinctly elevated.

Elytra with first striae strongly and others weakly impressed; punctures close, rather deep, and of moderate size. Interspaces rather flat above, somewhat convex on sides and declivity, narrower than striae.

Type locality: Lake Tahoe, Nevada.

Distribution: California to British Columbia.

Hosts: *Pinus ponderosa* and *Pseudotsuga menziesii*.

The species is not common but is quite widely distributed.
18 Genus HYLURGOPS Le Conte 76:389

Species of this genus are very closely related to Hylastes, in fact Hagedorn (1910) lists it as a subgenus of the latter.

Le Conte separates the species by the broad, bilobed third tarsal segment and the mesosternum is protuberant. The prothorax narrowed in front and more finely and densely punctured; antennal grooves very deep; front tibia less coarsely serrate than in Hylastes and the base of the elytra more rounded.

The common name of sour-sap beetles is applied to the group as explained under H. subcostulatus.

Four of the seven recognized species are found in the Northwest.

Key to Species of HYLURGOPS in the Northwest

1. Base of the elytra strongly arcuate and irregularly sub serrate; the elytral interspaces alternately carinate, more strongly behind; the elytra and pronotum everywhere minutely scaly, frequently encrusted. SUBCOSTULATUS (Mann.)
   Base of the elytra only moderately arcuate and not serrate; the elytral interspaces subequally sculptured ...................................................... 2

2. Stout species, elytra somewhat inflated behind; pronotum deeply sinuate on the sides in front, densely but rather regularly punctured; strial punctures coarse and indistinct, interspaces closely, coarsely rugose. RUGIPENNIS (Mann.)
   Rather slender species; not inflated behind; pronotum at most only slightly sinuate on the sides of the front ...................................................... 3

3. Pronotum with many minute and numerous medium sized punctures intermixed; the elytra deeply striate on the disk and declivity. POROSUS (Lee.)
   Pronotum with many large and a few minute punctures intermixed; elytra rather feebly striate .......................................................... LECONTEI Sw.

Hylurgops subcostulatus (Mannerheim) 43:297 The Sour-Sap Bark Beetle

This species was described as Hylastes subcostulatus by Mannerheim from material collected by the early Russian exploration parties along the northwestern coast of America. The species differs somewhat from the typical Hylurgops.

A medium-sized scolytid (length 3.4 to 4.5 mm.), rusty brown in color, with the base of the elytra strongly arcuate, subacute and irregularly finely serrate; the elytral interspaces alternately carinate, more evident behind; upper surface covered with minute scales; second abdominal segment longer than in other species.

Type locality: Alaska (near Sitka).

Distribution: Alaska to California and from the Pacific Coast eastward through the Rocky Mountain states.

Hosts: Various pines. Definitely recorded from P. ponderosa, P. contorta, P. monticola, P. lambertiana, and P. jeffreyi and probably attacks any species of Pinus in its range.

Life history and habits: As indicated by its common name this species is most often found in dead trees, especially trees or logs having wet, sour-sap cambium. The egg gallery is in a generally longitudinal direction and the larvae work in the cambium en masse so that where attack is heavy the entire
Cambium is destroyed. Pupation takes place in cambium or bark. There are two generations per year at lower altitudes.

The species is of no economic importance.

*Hylurgops rugipennis* (Mannerheim) 43:297 The Rough-Winged Bark Beetle

Described as a species of *Hylurgus.*

Body more elongate (4 to 5 mm. long); reddish in color; pronotum very narrow; elytra wider than the pronotum; asperities of the elytral interspaces coarser on the declivity; beak not carinate. The roughened appearance of the elytra and the densely, regularly punctate pronotum will serve to distinguish the species.

Type locality: Alaska.

Distribution: Widely distributed from Alaska to California east through the Cascade-Sierra Nevada range.


In western Oregon it is commonly found in dead Sitka spruce and Douglas-fir, more rarely in *Pinus contorta.* In the Cascade Mountains we have found it abundant in dead *Pinus monticola.* Patterson (1945) reports Washington specimens from Alaska cedar.

The work is similar to that of *H. subcostulatus,* the entire cambium being ultimately destroyed. Although not definitely established, it would appear that successive generations breed in the same tree (usually down timber) as long as sufficient material remains for the larvae to feed upon.

*Hylurgops lecontei* Swaine 17:16

Swaine says of this species; “Allied to *porosus* Lec., but smaller, with pronotal punctures coarser and denser, and the striae less deeply impressed on the declivity."

Length 4.1 mm.; pronotum arcuate on the sides; coarsely, densely granulate-punctate.

Elytra as in *porosus* except striae less distinctly impressed; interspaces only a little more prominent on the declivity than on the disk.

Type locality: Colorado.


Hosts: *Pinus ponderosa,* *P. contorta,* and *P. monticola.*

*Hylurgops porosus* (Le Conte) 68:175

A large species 5 mm. long; frontal impression deep, coarsely sculptured; elytra very hairy. Pronotum about as wide as elytra, widest at middle; base of elytra feebly arcuate.

Type locality: California (Cabo de los Reyes).

Distribution: British Columbia south through the eastern part of the Pacific Coast states and through the Rocky Mountain states to Utah.

Hosts: *Pinus contorta* and *P. monticola.*
Notes: In Le Conte’s type series of two specimens, *porosus* the second specimen (as mentioned by Le Conte) is *H. lecontei* collected by Davidson, (see Trans. Amer. Soc. II, p. 175, and Can. Bul. 14, part I, p. 16).

**Subfamily MICRACINAE**

Up to the time Blackman published his paper on this group in 1920, this subfamily was composed of three genera, *Micracis, Thysanoes,* and *Cactopinus.* Blackman (1920) describes three new genera, *Pseudothysanoes, Cryptotcoleptes,* and *Erineosinus* belonging to this division and in 1922 he described a species of *Hylocerus* from Arizona, thus adding another genus to the subfamily, as it occurs in America. Later (28:187) the same author described several additional species and transferred others to the genus *Hylocerus.*

The following subfamily characters apply to the one genus found in our territory:

![Antenna and tibia of Micracis (After Blackman)](image)

Head concealed from above; pronotum with anterior area rugose; abdominal sternites 5 to 7 horizontal; anterior tibia not distinctly broader or narrower toward the apex, not serrate on the outer edge, with a stout apical tooth, antennal club compressed.

The anterior tibia (fig. 62) has the outer edge entirely or nearly without teeth or serrations (some *Micracis* show faint evidence of these), sides nearly parallel with the ends of nearly the same width. The distal end is squarely to obliquely truncate on the outer half, and is armed with 2 to 5 submarginal teeth; the inner distal angle is a very evident mucro.

Antennae are important from a taxonomic viewpoint. The club is flattened oval to elongate, ornamented with long setae, (fig. 62) which are often arranged so as to form definite sutural lines; these lines are also punctured on both surfaces. Foretibiae and antennal structures will serve best in separating members from other subfamilies; the scape is club-shaped or flattened, more or less expanded at the upper distal angle, and always ornamented with fimbriated hairs. Number and length of these hairs vary even within the genus. There are six segments in the funicle.
19 Genus MICRACIS Le Conte 68:164

Adults of the genus Micracis vary considerably in size and proportions. The smallest species is *M. nanula* (1.62 mm. long), while *M. hirtellus* represents the maximum length (3 mm. long).

Variations in the antennae of Micracis have to do with shape and vestiture of the scape, shape, and proportions of the club and its divisions and sutures, relative size of the funicle, along with shapes and relative proportions of its various parts.

Most of the species in this genus have been taken from broad-leaf trees and ornamental shrubs; as a whole the genus confines its attack to small branches and twigs. Plants which are subject to attack fall in several families but all are broadleaved except in one case where a species is said to attack southern cypress.

Most of the species are found in the eastern United States. Only two species have been reported from the Pacific Coast, and only one species occurs in the Northwest.

Habits and galleries:

In this genus we have typical wood borers, excavating egg tunnels directly into the sapwood, where they may branch in several directions. Larvae mines extend longitudinally through the branch and may reach a length of 7 inches. For the most part the species work in dry wood of broken branches and hence are of little economic importance. They are not ambrosia beetles.

*Micracis hirtellus* Le Conte 76:368

Dark reddish-brown in color; 3 mm. long, very cylindrical. Front with small, slightly depressed area at center from which arises a tuft of short hairs, antennal scape slightly dilated distally and ornamented with long hairs; pronotum broadly rounded in front, anterior margin with faint serrations, anterior area with broad, flat asperities. Elytra with prominent sutural apex, impressed striae with close, coarse punctures, declivity convex, all interspaces coarsely granulate; vestiture longer and more conspicuous than usual (fig. 63). Front tibiae with sides about parallel, outer edge sharp, not serrate, terminal mucro large and curved at the end, four submarginal teeth. Male smaller with anterior margin of pronotum strongly serrate.

Type locality: Southern California, exact locality unrecorded.
Distribution: Quite generally distributed throughout California, Oregon, and Washington.

Hosts: Many varieties of trees and shrubs serve this beetle as hosts. Myrtle (*Myrica*), Alder (*Alnus*), Maple (*Acer macrophyllum*), Arbutus, *Ceanothus*, Umbellularia, *Quercus*, and Willow (*Salix*) are all attacked.

Habits: Attack is usually made on dead twigs of the host, the larvae working in the wood.
The species is not common in Oregon or Washington. Specimens have been examined from Portland, Forest Grove, Dayton, McMinnville, Salem, and Corvallis in Oregon; from Cedar Mountain and Seattle in Washington.

Subfamily Ipinae

This is the largest subfamily, containing 35 genera, and more than half of the species found in North America. There is wide variation in habits, many being true bark beetles, while several genera are made up of ambrosia beetles, and some like members of the genus Xylocleptes, have what might be termed aberrant habits, since they mine the stems of vines, etc.

Although a large percentage of the species is of little more than biological interest, some, such as various species of timber beetles (Trypodendron, Monarthrum, Xyleborus, etc.) are very destructive to the wood of both coniferous and broad-leaf trees. Various species of Ips and occasional species of other genera are of considerable economic importance since, in conjunction with other species or alone, they attack and kill perfectly healthy trees.

There is also considerable variation in structural characters as would be expected in a group containing more than 360 species. Some authors have divided the genera into several groups or subfamilies but we have retained the classification as used by Swaine (18).

The species are recognized by the following characters: The head is set well back in the pronotum and is not visible from above; the funicle of the antennae contains from 1 to 5 segments; the pronotum is always more or less roughened, or asperate, in front; the vestiture of the body varies from nearly glabrous, to sparsely, to densely, covered with scales, bristles, or hairs; foretibiae are serrate on the outer margin, widened distally, and are never strongly produced at the outer apical angle.

Key to Genera of Ipinae in the Northwest

1. Eyes divided; antennal club without distinct sutures; ambrosia beetles
   
   TRYPODENDRON Steph.

2. Eyes entire; antennal club with sutures at least at the tip

3. Antennal funicle composed of four segments

4. Antennal funicle composed of more than four segments

5. Antennal club broadly rounded, sutures straight, the first septate
   
   PROCRYPHALUS Hopk.

6. Antennal club large with three recurved sutures on anterior face indicated by rows of setae, not septate
   
   TAENIOGLYPTES Bedl.

7. Pronotum acutely margined on the sides; distal segment of antennal funicle much wider than second, club narrow, pointed at tip, sutures straight, not septate, basal half of pronotum without scale-like setae
   
   CRYPHALUS Eich.

8. Body very smooth, punctures and pubescence nearly obsolete except on the declivity; the pronotum closely but feebly asperate in front, with an acute, arcuate, transverse, short carina at the summit before the middle. Mouthparts sparsely clothed with hairs; ambrosia beetles
   
   GNATHOTRICHUS Eich.
Body usually rather strongly punctured and pubescent; pronotum strongly asperate in front without a transverse carina at the summit; mouth parts densely clothed with stiff hairs .................................................. 7

7. Body quite stout; pronotum with marginal granules indistinct; discal asperities extending over more than the cephalic half of the sides, and the disk evenly convex; antennal club not septate .................................................. 8

Body slender to only moderately stout; antennal club with sutures 1 and 2 septate; pronotal asperities usually not extending behind the middle of the sides .... 9

8. Body very stout, anterior margin of pronotum scarcely or not at all serrate; elytra with 9th interspace not noticeably elevated; antennal club and funicle about equal in length; segments 1 and 2 combined are longer than 3 and 4. Breeds in cones of various coniferous trees ............................... CONOPHTHORUS Hopk.

Body moderately stout; anterior margins of pronotum moderately to strongly serrate, 9th elytral interspace usually strongly elevated; antennal club a little longer than funicle, segments 1 and 2 shorter than 3 and 4 combined. Breeds in coniferous twigs ........................................ MYELOBORUS Blkm.

9. Pronotum and elytra finely to coarsely, sparsely punctured and pubescent; greatly developed hairs on the frons of the female are characteristic ....................... 10

Pronotum and elytra finely and densely punctulate and with very fine, dense pubescence; antennal club with first segment much narrower than others. Frontal hairs greatly developed in the male. Breeds in broad-leaf trees, primarily oak in this area ........................................ PSEUDOPITYPHTHORUS Sw.

10. Pronotal asperities usually extending nearly one-half of the way back of the sides in both sexes; elytral declivity more or less strongly sulcate; antennal club never twice as long as the funicle; mostly twig borers ............................ PITYOPHTHORUS Eich.

Pronotum and elytra finely and densely punctulate and with very fine, dense pubescence; antennal club with first segment much narrower than others. Frontal hairs greatly developed in the male. Breeds in broad-leaf trees, primarily oak in this area ........................................ PSEUDOPITYPHTHORUS Sw.

Pronotum strongly declivitous and strongly asperate in front, not granulate behind ............................................................... 11

11. Front tarsi only moderately widened distally; mouth parts clothed with numerous stiff hairs; elytral declivity usually toothed or excavated or both .......................... 12

Front tarsi strongly widened distally; mouth parts with sparse slender hairs. Ambrosia beetles .............................................................. 16

12. Prosternum very short and oblique in front of the coxae; intercoxal process short, wide, not extending far between the coxae; front of female usually deeply excavated; antennal club flat, compressed with sutures on both sides. Declivity moderately excavated and with prominent teeth ............................. PITYOGENES Bedel.

Intercoxal process of the prosternum long and acute; the front not deeply excavated in either sex; antennal club usually without sutures on the inner side, or only at the extreme tip ............................................................... 13

13. The concavity of the declivity separated from the apical margin of the elytra by the strongly produced, horizontal, platelike, acute, apical margin of the declivity; the antennal club flattened, sutured throughout on the upper face; the "trough" of the male genitalia divided into two short rods; the ligula depressed and the mentum very slender; bark beetles ........................................ IP S De G.

Declivity with apical margin only slightly produced, at most forming a very short acute apical ridge, the plate dividing the declivital apex from the elytral apex, when present, oblique and very short; the antennal club thickened at the base, and obliquely truncate distally on the upper face; the ligula pine cone shaped, the mentum moderately elongate ........................................ 14

14. Front of the female not densely clothed with long yellow hair .............................................................. 15

Front of the female densely clothed with very long yellow hair; the declivital concavity less pronounced, with the apical declivital margin almost absent towards the middle of the apex so that the sutural sulci extend to the apical margin of the elytra; the antennal club usually wider than long, strongly depressed distally; the seventh tergite with spiracles ........................................ PITYORTEINES Fuchs.
15. Apical margin of the declivity broadly rounded; declivity subaculeate armed with small, pointed granules in both sexes; antennal club subcircular, barely longer than wide, flattened distally, not obliquely truncate ....................... ORTHOTOMIDES Wood

Apical margin of the declivity acute; declivity not deeply concave, the concavity bordered posteriorly by an acute, distinct apical margin; antennal club longer than wide, obliquely truncate on outer distal face ....................... ORTHOTOMICUS Fert.

16. Body very stout; the pronotum subcircular with the cephalic margin serrate at the middle line in the female, the mesepimeron strongly widened laterally; the metepisternum only very faintly emarginate behind; the scutellum distinct, not depressed; ambrosia beetles ........................................... ANISANDRUS Fert.

Body slender, the pronotum not serrate on the cephalic margin; the mesepimeron feebly widened laterally, the sides subparallel, the metepisternum rather strongly emarginate on the inner side behind; ambrosia beetles ..................... XYLEBORUS Eich.

20 Genus TRYPODENDRON Stephens 30:353

Members of this genus are easily recognized by their stubby appearance (figs. 65 and 67); roundish prothorax, more than one-half as long as the abdomen; smooth, shining body, and the divided eyes. The antennal club is entire, with the basal segment strongly angulated in front and produced towards the middle (fig. 64); the metepisternum strongly sinuate behind the inner side. Sexes of nearly equal size; males with front deeply excavated. Elytral declivity is neither excavated nor armed. The only other genus of ambrosia beetles with divided eyes is Xyloterinus, no species of which is found in the Northwest.

Trypodendron are all ambrosia beetles and attack either conifers or in distribution, extending into northern broadleaves. They are essentially northern Canada and Alaska, with a few species ranging into the southern states.

Some species show stripes of a lighter color on the wing covers; this is quite unusual with Scolytidae.

Galleries of Trypodendron are similar to those of species belonging to other genera of ambrosia beetles. They penetrate the bark, extending into the sapwood and very often the heartwood; there may be several branches. The galleries are stained black due to fungi reared on the walls for food. The young are reared in separate cradles (fig. 75) arranged in series above and below the main tunnel. The initial entrance tunnel is excavated by the female, followed closely by the male. They are apparently monogamous.

Damage inflicted by species of this genus may be severe. Vigorous, growing trees are seldom targets, but trees damaged by lightning, wind, fire, drought, or by the onslaught of other insects are readily attacked; logs will suffer severe injury if left in the woods during the flying season. The mines penetrate deep into the wood, the fungi discolor the wood for some distance, and the value of lumber from such trees or logs is ruined for the better grades.
THE SCOLYTOIDEA OF THE NORTHWEST

Key to Species of TRYPODENDRON in the Northwest

1. The carina forming the lateral margin of the declivital sulcus wide and irregularly punctured; pronotum not asperate, rounded in front with four teeth on the anterior margin. Large species 3.8 to 4.5 mm. long. Host poplars ........... RETUSUM Lec.
   The carina forming the lateral margin of the declivital sulcus narrow and uniserially punctate; pronotum asperate, smaller species 3 to 3.7 mm. Hosts coniferous trees .............................................. 2

2. Surface shining, declivity steep, with alternating dark and light stripes ........... .......................... LINEATUM Oliv.
   Surface not shining, declivity sloping but not steep, narrowly rounded without definite stripes ..................................................... RUPITARSIS (Kby.)

Trypodendron retusum (Le Conte) 68:158
   Described as Xyloterus retusus.
   A stout, cylindrical, shining, brownish-black species (fig. 65) about 3.5 to 4.5 mm. in length; head with concave front, sparsely, finely clothed with erect hairs. Prothorax broader than long, broadly rounded in front and behind; convex, very strongly declivous and broadly impressed, asperate, in front; with four teeth on the front margin of female, not so in male; and clothed with sparse, long, erect hairs in front. Elytra with indistinct rows of fine, shallow, impressed punctures. Female with head convex in front, with small granules and a small depression in front. Antennae with a long bristle arising from the anterior edge of each segment of the funicle and from the first and second segments of the club; antennae of the male with short, stiff hairs; no long bristles.
   Type locality: Canada; exact locality not given.
   Distribution: Widely distributed in United States and Canada.
   Host: Poplar: Populus grandidentata, P. tremuloides, and probably other poplars. Dodge (38:36) reports finding this species in paper birch.
   Apparently quite common in the Northeastern states and in eastern Canada, less common in the West. It prefers injured trees which are still green, and recently cut logs.
   Habits and work: Under the name, Xyloterus retusus, Hubbard (97:29) describes the work of this species as follows: “Several pairs of the beetles unite in colonies, having a single entrance, but each family occupies its own quarters, consisting of 1 or 2 branch galleries. The galleries do not penetrate deeply into the heartwood.
"Each female attends her own broods, which are raised in cradles (fig. 66) extending upward and downward at right angles to the main passageway. She feeds the young with a yellowish ambrosia grown in beds in the neighborhood of the cradles. The mouth of each cradle is constantly kept filled with a plug of the food fungus.

"The ambrosia consists of oval cells which form upright sticks resembling some forms of styliform ambrosia, but do branch and are capable of being broken up into bead-like masses without losing their vegetative powers."

Fig. 66. Galley of Trypodendron Trypodendron lineatum (Olivier) 95:18
Described as Bostrichus lineatus.

T. bivittatum (Kirby) 37:192; T. vittiger Eichhoff 80:298; T. cavifrons Mannerheim 43:297; T. borealis Swainson 17:21 are synonyms.

Most authors list T. bivittatum and ignore T. lineatum. If the two species are the same, Olivier's name has priority of more than 40 years.

Kirby's original description and Le Conte's remarks are as follows:


"Very near A. domestica (A. limbata F.) but distinct. Body picaceous or nigropiceous, cylindrical; underneath with some scattered pale hairs. Head rough with minute elevations or granules; nose terminating in a transverse ridge; antennae testaceous with a very large knob; prothorax subglobose, reddish, rough behind with numerous transverse rugosities; before with sharp points or denticles; elytra with several rows of punctures, and two luteous stripes which unite at the apex of the elytron; or perhaps it might be better to say, luteous with two picaceous stripes, one of the disk and the other of the side, but not reaching the apex; anus and legs testaceous."

In the other sex, the front, or rather face, is hollowed out into a concavity; the prothorax is black anteriorly, and less rough from rugosities and points. Le Conte, 1868, states "belongs the genus Xyloterus, Er." and that this species is taken from "Maine to Alaska." In the male the head is concave, and the thorax finely, transversely asperate before the middle; the male is usually smaller than the female. In the female the head is convex and the thorax much more roughly asperate. This species varies greatly in color; the black elytral vittae sometimes occupy nearly the whole surface and sometimes are almost wanting.

Type locality: Lineatum, "Boreal America"; bivittatum, somewhere in Canadian Rockies.

Distribution: Widely distributed in the United States and Canada.

Hosts: It is reported to attack species belonging to nearly all our coniferous genera, Abies, Larix, Picea, Pinus, Tsuga, and Pseudotsuga, while a similar or identical species works in Juniperus, Sequoia, and Thuja.
Habits and work: Male and female work together in constructing the galleries. The young are raised in separate cells, where they remain until they reach the adult stage. Eggs are deposited in shallow niches, cut by the female, along the sides of the tunnel, and usually well back from the entrance; the larvae extend these niches into short tunnels or larval cradles in which they pupate.

The galleries penetrate sapwood and heartwood and often branch considerably; the brood chambers, which are arranged in series, extend above and below the main galleries. Ambrosia fungus furnishes the food supply, and the stain from this fungus discolors the wood for some distance from the mines.

This is the most abundant species in the Northwest and is a serious pest in recently felled trees and logs.

*Trypodendron rufitarsis* (Kirby) 37:193

Described as *Apate rufitarsis*, *T. ponderosae* Swaine 17:22 is a synonym.

This species belongs to the (*bivittatum*) *lineatum* group and has been considered by many as a synonym, Swaine (17:22) points out that after comparing specimens with the type, he considers it a distinct species.

The female is similar in size and shape to *lineatum*, but elytra are distinctly narrower toward the base, and wider behind the middle. Punctures of pronotum are more minute and nearly obsolete on the sides and behind; front of head less densely, but more coarsely, granulate on the upper half. Elytral striae very narrow, slightly impressed, punctures small and closely placed; interspaces flat, punctures sparse, setae short and slender. The color is black, antennae and legs dark red-brown. The median band of the pronotum is less than one-third the width, extending from the base across the summit to the apex, dark, smoky-red. Elytra without stripes, dark reddish, sides darker. The declivity has the second interspace very narrow, slightly impressed, without punctures; first and third interspaces not strongly elevated, and granules almost obsolete.

The dull color, the coarsely, sparsely granulate front, the shallow declival sulcus and nearly obsolete granules of the declivity, and the unarmed anterior margin of the pronotum in the female should separate it from other allied species.

Type locality: Canadian Rockies. Kirby does not state the exact locality.

Distribution: Western Ontario to British Columbia and across the northern states. It is found in Idaho, Oregon, Washington, and British Columbia.

Hosts: *Pinus resinosa*, *P. contorta*, *P. ponderosa*, occasionally in *Picea*, *Abies* and *Pseudotsuga*.

Habits: The habits so far as known are very similar to those of *T. lineatum*.

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Fig. 67. Adult *Trypodendron rufitarsis*
**Genus MONARTHUM Kirsch 66:213**

**HISTORICAL**

Swaine (18:86) uses the generic name *Pterocyclon* Eichhoff (68:276). If these names are synonymous, Kirsch's name has priority by two years. *Monarthrum* has been recognized for years and cannot be disregarded on the grounds that Kirsch's description was inadequate.

Members of this genus are separated by the funicle of the antennae having two segments, the apex of the elytra being emarginate, and the first segment of the palpi being cylindrical and glabrous.

North American species are 4 in number, with 2 found in the East and 2 in the West. A single species* is found in the Northwest and although two of the species are recorded from pine, these must refer to species of some other genus, since species of *Monarthrum* probably confine their tunnels to the broadleaves.

*Fig. 68. Adults of *Monarthrum mali*

*Monarthrum scutellare* (Le Conte) 60:59 The Oak Ambrosia Beetle

Described as *Corthylus scutellare*.

Synonym *Cryphalus caeus* Le Conte (68:153)

Length, 3.5 to 4.1 mm. Color, brownish, becoming black near the caudal end. Body very cylindrical (fig. 68); antennal funicle of two segments; club distinctly compressed with two deep, straight, and transverse sutures.

The female is distinguished by a tuft of long hairs on the margin of the antennal club; the presence of a well-developed epistomal process, bifid at the apex; and the declivity being plano-convex. The male lacks the long hairs, has a broad epistomal process and a convex declivity.

Type locality: California.

Distribution: British Columbia south into California. Known from Oregon, Washington, and British Columbia.

Hosts: California live oak (*Quercus agrifolia*), western white oak (*Q. lobata*), California black oak (*Q. kelloggii*), Oregon white oak (*Q. garryana*), and interior live oak (*Q. wislizenii*).

Habits and work: Like most of the ambrosia beetles, this species attacks dying, weakened, diseased, and recently dead trees, or parts of trees, such as suppressed limbs, stumps, etc.

The main gallery (fig. 69) is excavated by the male who penetrates the

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*Patterson and Hatch (1945) report *Monarthrum dentiger* Lec. from Seattle, Washington in error.*
bark and extends into the sapwood for about one-fourth of an inch where a nuptial chamber is formed. From this point four (possibly only 2) galleries extend into the sapwood. These galleries are the work of the female, and according to Doane (29:916), the male may help in excavating these egg galleries. Doane states that in these galleries the females cut niches for the eggs and that the larvae excavate the cells which are at right angles to the gallery and parallel to the grain of the wood. That author also states that only a single pair of beetles occupies the completed system of galleries; copulation takes place in the nuptial chamber at frequent intervals during the progress of the work.

The egg galleries are from 2 to 6 inches long; the cradles may be opposite, but more often are alternate in their situation. Eggs are laid at intervals as the tunnels progress and may extend over a period of 2 to 4 months. In California there are two egg laying periods, one in March and the other beginning in October, resulting in two generations per year. Larvae require 6 to 8 weeks for full development. The pupae remain in the cradles for development and transformation to adults, which requires 2 to 3 weeks.

Fig. 69. Galleries of Monarthrum
(From Keen)
22 Genus CRYPHALUS Erichson 36:61

In our area members of this genus are separated from closely allied genera, Taenioglyptes and Procryphalus, by the absence of a distinctly raised lateral line on the pronotum; antennal funicle of 5 segments, the fifth much wider than the second; the club (fig. 70) elongate, slender, and pointed, with three straight sutures indicated by rows of setae; and the third tarsal segment cylindrical or laterally compressed. Frons weakly convex with scanty pubescence.

Pronotum wider than long, with numerous large broad asperities on the anterior portion. Foretibiae (fig. 70) broadened distally with eight teeth on outer margin of the distal one-third.

Elytral striae variable, declivity rather steep, often with a broad impression between the first and fourth interstriae. Sexes similar.

Two species of this genus occur in the Northwest; both are rare. Other species formerly assigned to Cryphalus are now placed in the genus Taenioglyptes.

Species of Cryphalus tunnel in the bark of the main bole or larger limbs more than 2 inches in diameter and seldom reach the cambium. The main gallery is an irregular cave, quite small, 2 to 6 millimeters wide and much longer. There is evidence of fungus staining the walls but not serving as food as in the case of ambrosia beetles. The species are monogamous and mate repeatedly in the cave. Eggs are deposited in clusters in galleries excavated by the parent beetles and the larvae excavate very short, irregular tunnels into the bark. Only a few eggs are deposited in each tunnel.
Key to Species of CRYPHALUS in the Northwest

Strial punctures coarse, deep, especially on the basal half; punctures on posterolateral areas of the pronotum are rather large, deep, and close; scalelike pubescence confined to the declivity .................................................. NITIDUS (Sw.)

Strial punctures greatly reduced except on basal one-fourth, punctures on posterolateral areas of the pronotum rather small, shallow and less close; scalelike pubescence covering the posterior half of the elytra ........................................ SALCIS (Hopk.)

Cryphalus nitidus (Swaine) 12:349

Synonym: Trypophloeus punctipennis Hopkins 1515:37

The species was described as Trypophloeus nitidus by Swaine and transferred to Cryphalus by Wood (44:99).

The species may be distinguished by the characters given in the key.

Length 1.6 to 2.0 mm.

Type locality: Weymouth, Nova Scotia.

Distribution: Apparently the most widely distributed species of this group having been reported from Nova Scotia, Quebec, Minnesota, Utah, and Idaho.

Hosts: Various species of Alnus and Salix.

The only record from the Northwest is specimens taken at Coeur d’Alene, Idaho, probably from Alnus rhombifolia.

Cryphalus salicis (Hopkins) 15:36

Synonym Trypophloeus concentralis Hopkins (15:36).

This species was described by Hopkins as Trypophloeus salicis and like the previous species has been placed in Cryphalus by Wood.

The characters as given in the key will distinguish the species. Length 1.5 to 1.7 mm.

Type locality: Del Norte, California.

Distribution: California to Washington.

Hosts: Alnus and Salix. Species not specified.

This species is evidently very rare. Specimens reported from this area were taken in eastern Washington at Easton and Fort Flagler. Although specimens have not been reported from Oregon the species undoubtedly occurs in this state.
23 Genus TAENIOGLYPTES Bedel 88:393

Although very closely allied to *Cryphalus* the species may be separated by the following characters: antennal funicle (fig. 71) of 4 segments (5 in *Cryphalus*), club large, with 3 recurved sutures on the anterior face indicated by rows of setae; third tarsal segment rather broad and emarginate.

Convex frons with scanty pubescence. Pronotum wider than long; basal margin and posterior one-third of lateral margin with a fine elevated line; asperate in front of summit. Anterior margin with 3 to 8 teeth; vestiture hairlike.

Elytral striae fairly distinct with small punctures, interstriae rather wide with confused punctures, declivity steep without special elevations or impressions.

Unlike the two previous genera of *Cryphalini*, members of this genus are found only in coniferous trees.

Species of *Taenioglyptes* usually attack the main stem of young trees, seedlings or broken branches. They are monogamous and mate outside the galleries. Galleries are similar to those of *Cryphalus* with one important difference in that they lie largely in the cambium. The cave is more regular in outline; eggs are deposited in small clusters about the periphery with the larval tunnels longer and forming a more definite pattern than in those of *Cryphalus*.

Key to Species of TAENIOGLYPTES in the Northwest

1. Interstrial bristles of the declivity pronounced, hairlike, each distinctly longer than the distance between the rows of bristles ............................................. *PUBESCENS* (Hopk.)
   Interstrial bristles on the declivity inconspicuous or absent ............................................. 2

2. Posterolateral areas of pronotum closely granulate-punctate; striae less prominent, punctures less deep; interstriae rugose ............................................. *RUFICOLLIS* (Hopk.)
   Posterolateral areas of pronotum with punctures more distinct, less granulate; striae more prominent, punctures deeper and slightly larger, interspaces less rugose ............................................. *RUFICOLLIS AMABILIS* (Chamb.)
Taenioglyptes pubescens (Hopkins) 15:40
Synonym Cryphalus subcentricus Hopkins 15:40
Described as Cryphalus pubescens by Hopkins.
This species is distinguished by the presence of very long interstrial hairlike bristles which are longer than the distance between the rows of bristles. Length 1.6 to 1.9 mm. Sexes similar.
Type locality: Port Williams, Washington.
Distribution: British Columbia to California.
British Columbia: Pender Harbor and Saanichton.
Washington: Olympic National Forest, Port Williams and Fort Flager.
Oregon: Astoria, Marshfield, Santiam National Forest, and Linn County.
Hosts: Reported from Abies grandis, A. lasiocarpa, Pseudotsuga menziesii, Pinus lambertiana, and Sequoia sempervirens.
The species usually attack young weakened trees 4 to 8 inches in diameter, also broken limbs and seedlings. In the latter, entrance is usually just below a lateral twig. Mines are cave-like oval, circular, or elongate and are in the cambium region. Eggs are in small clusters at the edge of the cave and the larvae work out in any direction.

Taenioglyptes ruficollis ruficollis (Hopkins) 15:40
Described as Cryphalus ruficollis by Hopkins.
Synonyms:
Cryphalus approximatus Hopkins 15:41; Wood 54:1005
Cryphalus grandis Chamberlin 17:323; Wood 54:1005
Cryphalus canadensis Chamberlin 18:88; Wood 54:1006
Cryphalus mainensis Blackman 22:126; Wood 54:1006
T. ruficollis is widely distributed and Wood (54) recognized two subspecies, one of which occurs in our territory.
Wood characterizes this species as follows:
“This widely distributed form is closely allied to T. fraseri and T. ruficollis coloradensis; it differs from T. fraseri by the distinctly impressed striae punctures, and the less granulate posterolateral areas of the pronotum. From T. r. coloradensis it is distinguished by the more closely punctured pronotum, with at least the posterolateral angles granulate, and the smaller average body size.
“Female: Length 1.45 to 1.85 mm., 2.30 times as long as wide, body color dark brown.
“Frons weakly convex, with a short, often indistinct, median, longitudinal elevation near epistoma; surface coarsely reticulate over a larger area, Pubescence consisting of inconspicuous, sparse, fine hair of medium length, and a more conspicuous ventrally directed epistomal brush. Antennal club longer than scape, with three recurved sutures on anterior face marked by rows of setae.
“Anterior margin of pronotum rather broadly rounded, bearing from 4 to 8 marginal teeth which decrease in size laterally; summit on basal third; asperate in front of summit, the asperities rather abundant, large; usually
narrow, rarely arranged in one or more subconcentric rows near summit; posterior and lateral areas closely, rather finely, deeply granulate-punctate; more granulate basally; pubescence consisting of rather short, fine, recumbent hair, coarse on asperate area.

"Elytra shining; striae usually not impressed, the punctures distinctly impressed, rather fine, separated by a distance greater than their own diameters; interstriae 2 to 3 times as wide as striae, the punctures fine, abundant, confused. Declivity rather steep, convex, the strial and interstitial punctures obsolete. Elytral vestiture consisting of uniserial rows of short, hairlike, strial setae.

"Male: Similar to female, but usually the elytral scales are slightly larger.”

Type locality: Alta, Utah.
Distribution: From Maine to British Columbia, south; in the mountains of Utah and Oregon. Localities in the Northwest where specimens have been taken are:
Idaho: Sand Point.
Washington: Mtlene Falls and Naches Ranger Station.
Oregon: Corvallis.

Taenioglyptes ruficollis amabilis (Chamberlin) 17:321
Described as Cryphalus amabilis.
The species is very similar to the typical ruficollis but more distinctly punctured on the posterior lateral of the pronotum. The striae and strial punctures are more prominent while the interspaces are more smooth.
Type locality: Elk Lake near Detroit in Linn County, Oregon.
Distribution: Western Oregon, Washington, and California. Oregon specimens are all from the area near Detroit, in eastern Linn County. Washington: Lodgepole Forest Camp and Naches Ranger Station.
The adult made a tiny entrance hole just below branches of small trees and a small oval chamber was eaten out. These chambers averaged from \( \frac{1}{4} \) to \( \frac{1}{2} \) inch across the longest diameter and from 20 to 25 eggs are deposited therein, mingled with fine bark boring. Larvae, when first emerged, are about the size of the egg and grow very slowly for some days; they develop to slightly over 2\( \frac{1}{4} \) mm. long but never become very active. Pupae are from 1\( \frac{1}{4} \) to 2 mm. in length and \( \frac{1}{2} \) to \( \frac{3}{4} \) mm. broad. The pupal cells are in the cambium.
Eggs are deposited the last week in August and hatch in five days; the slightly yellowish larvae work out in all directions from the egg chamber, girdling the small limbs and covering a space of 5 to 6 square inches. Both male and female work at excavating the egg chamber. This species has also been found working in Douglas-fir saplings.
24 Genus PROCRYPHALUS Hopkins 15:33

Members of this genus are distinguished (Wood 54:981) from the closely related genera by the absence of a distinct raised line on the basal and lateral margins of the pronotum; the first suture of the antennal club completely septate; posterior costal margins of the elytra only slightly ascending.

Frons convex, rather broad, punctured, with scanty pubescence. Antennal club (fig. 72) elongate oval, with 2 distinct straight sutures, first completely septate, the second indicated by setae, third rather obscure; funicle 4-segmented.

Foretibiae (fig. 72) with teeth on the distal outer margin, hind tibia broad, with five teeth on distal one-fourth.

Elytral declivity rather steep, convex with abundant short scalelike setae. Sexes similar.

There are three species in this genus and all are found in our territory. Galleries of Procryphalus are very similar to those of Cryphalus. Their walls are stained black, presumably as a result of the growth of a symbiotic fungus which may assist the beetles in overcoming the living tissues of the host. The beetles are monogamous and both sexes are found in the galleries. Repeated mating probably occurs since many mating pairs are found when the galleries in various stages of construction are opened. Eggs are deposited in clusters in the parental galleries. The larvae mine into the surrounding bark, often moving only 4 or 5 millimeters from their starting point; their course is very irregular.

Key to Species of PROCRYPHALUS in the Northwest

1. Strial punctures large, close; interstriae narrower than striae, punctures fine, sparse, surface smooth except for punctures; in Acer macrophyllum .... ACERIS Hopk.
   Strial punctures of small to medium size; interstriae as wide or wider than striae, punctures more numerous, confused, surface granulate, at least near the elytral base 2

2. Smaller than 1.7 mm.; frons rather sparsely, shallowly punctured; interstriae more sparsely, finely punctured on posterior three-fourths of disk; in Salsola scoulerianna ... UTAHENSIS Hopk.
   Larger than 1.8 mm.; frons coarsely, rather deeply punctured; interstriae densely, rather coarsely granulate-punctate over entire disk; in Populus tremuloides ... MUCRONATUS (Lec.)
Procryphalus aceris Hopkins 15:33

In addition to characters given in the key the pronotum has only six marginal teeth which will separate it from the closely allied _P. utahensis_. Length 1.55 to 1.65 mm. This is the only species known from Oregon and the host is maple which should aid in defining it.

It is a rare species known only by the type series taken at Albany, Oregon, many years ago by A. D. Hopkins.

Type locality: Albany, Oregon.

Distribution: Known only from type locality.

Host: _Acer macrophyllum_.

Procryphalus utahensis Hopkins 15:33

Synonym _P. salicis_ Hopkins 15:33

Separated from the other two species by the presence of eight teeth on the anterior margin of the pronotum and the more coarsely granulate punctate elytral interstriae of the anterior one-sixth of the elytra. Length 1.5 to 1.7 mm.

Type locality: Alta, Utah.

Distribution: Idaho, British Columbia, Colorado, Utah, South Dakota, California, and Quebec.

Hosts: _Salix scouleriana_ and _Salix_ sp.

The Idaho specimens are from Minidoka National Forest and the British Columbia locality is Copper Mountain.

Procryphalus mucronatus (Le Conte) 79:518

Synonyms:

_Cryphalus mucronatus_ Le Conte ibid.

_Procryphalus idahoensis_ Hopkins 15:34

_P. populi_ Hopkins 15:34

Closely allied to _P. utahensis_ but larger (length 1.8 to 2.2 mm.) more coarsely, closely punctured frons, the more strongly produced anterior pronotal margin with only six teeth, and the more coarsely, closely granulate-punctate elytral interspaces will aid in separating the species. The host and the fact that the species seem to occur at high altitudes will help in identification.

Type locality: Veta Pass, Colorado.

Distribution: Southern Idaho, Colorado, Utah, and eastern Nevada at higher elevations.

Host: _Populus tremuloides_

Idaho specimens came from Beaver Canyon and Franklin Basin.
Many of the species in this genus were originally described in, or have been placed in other genera such as *Tomicus*, *Crypturgus*, and *Pityophthorus*.

The species are difficult to identify and among the small number ascribed to North America there is considerable confusion.

The genus is readily separated from allied genera by its general appearance. In the latest revision of the genus, Blackman (31:264-276) recognizes 3 species, and describes 3 new species, making a total of 6 for North America. Of these 3 occur in the Northwest.

*Gnathotrichus* is one of the several genera of ambrosia beetles and is distinguished by its long cylindrical body (fig. 74) with the pronotum more than one-half the length of the abdomen. The head is completely hidden from above; antennal club large, of 3 segment sutures prominently septate; funicle of 5 segments and about two-thirds as long as the club.

Pronotum wide with numerous broad, low asperities on the anterior portion. Elytra with fine strial punctures, nearly glabrous except on the caudal third.

The galleries consist of a tunnel (fig. 75) through the bark into the wood with numerous laterals usually more or less parallel with the annual rings. Larval cradles are in these laterals above and below the mine. All tunnels are stained black due to the fungi which are grown as food for both adults and larvae. They live a more or less social life and the colony will remain as long as there is sufficient moisture in the wood to support the fungus gardens.

**Key to Species of GNATHOTRICHUS in the Northwest**

1. Front of head punctured at sides, median area elevated; antennal club with septa of first and second sutures nearly transverse; foretibia with three submarginal teeth

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Fig. 74. Adult *Gnathotrichus retusus*
Front of head distinctly convergently aciculate; antennal club with septa of first and second sutures strongly arcuate; pronotum with carina weakly elevated; foretibia with only two submarginal teeth

2. Elytra with declivital sulcus narrower, the sides less strongly retuse, and granules finer; the posterior margin moderately extended; in conifers Retusus (Lec.)
Elytra with declivital sulcus wider, sides strongly retuse and granules coarser; posterior margin more strongly extended; in alder Alni Blkn.

Gnathotrichus retusus (Le Conte) 68:155

Small cylindrical species 3.5 to 3.8 mm. in length, dark reddish-brown, often lighter on the pronotum and at the base of the elytra. Club of antennae with prominent, strongly arcuate, septate sutures. Strial punctures distinct, fine, rather deep, and in regular rows; interspaces without punctures on the disk, but sparsely punctate on the sides. Declivity strongly sulcate in the suttural area, with sides strongly retuse and armed with a row of denticles.

Females have a few long hairs on the antennae which are lacking in the male.

The adult beetle enters through the bark and penetrates the wood, making a cylindrical tunnel about 1 mm. in diameter. After attaining a depth of 2 or 3 inches, the gallery may, and usually does, branch in more or less irregular fashion. Though the galleries branch considerably, all parts of a single gallery will be on the same horizontal plane. Usually a long side-tunnel is cut about an inch inside the bark; this gallery runs parallel to the annual rings. Outside the entrance hole will be found a quantity of fine white borings lodged in the bark scales, etc.

Elongate eggs are deposited in cuplike niches made by the female both above and below the main galleries. Each niche contains a single egg. The larva hatching from this egg lengthens its niche slightly, grows, and transforms to an adult within this cradle (fig. 75).

The food of both larvae and adults is a species of ambrosia fungus which grows upon the walls of the tunnels. Broods reproduce and continue to extend their galleries as long as the wood of their host is in the proper state for growing the fungus.

There are undoubtedly two broods a year and these are not
regular since larvae, pupae, and adults are present within the galleries during the warmer portion of the year.

Type locality: California.

Distribution: British Columbia south to California, east into Nevada and South Dakota. Common in the Northwest.

Hosts: *Pinus ponderosa, P. contorta, P. jeffreyi, P. radiata, P. monticola, P. lambertiana, Abies grandis, A. magnifica, Pseudotsuga menziesii,* and *Tsuga heterophylla.* Specimens in the Portland Forest Insect Laboratory are labeled *Sequoia sempervirens.*

Habits and work: They mine the sapwood and heartwood of injured, dying, or recently dead trees, logs, stumps, and large limbs. Occasionally they will be found working in living and apparently healthy trees.

**Gnathotrichus alni** Blackman 31:271

A larger species, female 4.04 mm. long; dark, reddish-brown. Front of head convex, triangular callus above, moderately punctate below, except on the elevated, median, carinal space which ends in a small, sharp epistomial process; pubescence scanty. Antennae as usual. Pronotum one-quarter longer than wide, widest near posterior margin; anterior margin extended and armed with very broad, low serrations; asperities very low and broad; summit marked on the anterior portion by rather strongly elevated carina, longer than in *retusus*; posterior to summit moderately shining; punctures rather fine, deep, and sparse. Elytral stria 1 punctures fine, rather deep, and in regular rows; interspaces with few or no punctures and nearly glabrous on the disk; more numerous on the sides and declivity. Declivity less abrupt than in *retusus*; strongly sulcate in the sutural area, more widely than in *retusus*; sides armed with a row of denticles.

Male antennae lack the longer hairs on the outer margin; pronotum more broadly rounded and more strongly serrate in front.

Type locality: Hoquiam, Washington.

Distribution: Washington, Oregon, and British Columbia.

Host: Red alder, *Alnus rubra.*

**Gnathotrichus sulcatus** (Le Conte) 68:155

Described as *Cryphalus sulcatus.*

The female is 3.5 mm. long and of the usual dark reddish-brown color. Front of head strongly, convergently aciculate, median area broadly, indistinctly elevated below, smooth above, and shining, with coarser, sparser punctures and a distinct median carina on the vertex; antennal club 1.78 times as long as funicle; septa strongly arcuate. Pronotum one-fourth longer than wide, front margin broadly rounded, distinctly extended and armed with very broad, flat serrations; anterior area with more or less concentric rows of low, broad serrations. A feebly elevated transverse

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*Fig. 76. Adult Gnathotrichus sulcatus*
carina anterior to the middle; area posterior to this is feebly shining, finely reticulate, and has shallow punctures. Elytral strial punctures minute and in fairly regular rows; interspaces with minute punctures, bearing stiff hairs of moderate length on the declivity, which is convex; sutural region moderately sulcate (fig. 76) but less so than in retusus; lateral elevations moderate, with a row of minute granules in line with the third interspace.

Type locality: Middle California.

Distribution: British Columbia to New Mexico and quite common in western Oregon and Washington.

Hosts: Probably attacks any conifer within its range. It is definitely known to attack Pinus ponderosa, P. monticola, P. contorta, Picea sitchensis, P. engelmannii, Tsuga heterophylla, T. mertensiana, Pseudotsuga menziesii, Abies concolor, A. magnifica, A. grandis, A. procera, Thuja plicata, Sequoia sempervirens, and S. gigantea.

Habits and work: This species works in dying or recently felled trees, logs, tops, stumps, and larger slash. Evidence of attack in standing trees and stumps is the usual accumulation of white sawdust in cracks and crevices, and around the bark scales. In downed material, it collects in little mounds. The entrance tunnel runs directly through the bark into the sapwood where several branch galleries, usually 4, will be found. These branches are from 4 to 10 inches in length. Larvae are reared in pockets above and below the main gallery (fig. 75). The eggs are deposited in niches and covered over; the larvae deepen these niches as they grow.

26 Genus CONOPHTHORUS Hopkins 15:429

The first species of this group was described by Schwarz as Pityophthorus coniperda in 1895: the balance of our species, 14 in number, were described by Hopkins in 1915 at the time he described the genus.

Description of the genus Conophthorus:

"Pronotum with sides broadly rounded from near base to apex, slightly constricted beyond middle with base margined; abdominal sternite 7 with posterior margin procurved; pygidium vertical when in contact with posterior margin of sternite; pronotal rugosities extending toward or to lateral margin; tarsi with joint 5 not as long as joints 1 to 4 united; antennal (fig. 77) club compressed, not thickened at the base with 3 sutures on anterior and 2 on posterior face, sutures 1 and 2 without septum; eyes acutely emarginate." Tibia as figured (fig. 77).

"The genus Conophthorus is at once distinguished from Pityophthorus by the absence of sutural septa in the antennal club" (Hopkins).
The species work very largely in young cones, more rarely in the twigs, of the various pines. They occasionally become numerous enough to destroy as much as 50% of the seeds on restricted areas. Miller (1914 and 1915) gives an excellent account of some of the western species.

Of the 14 species listed by Hopkins (15:429), 5 have been reported from the Northwest.

**Key to Species of CONOPHTHORUS in the Northwest**

1. Elytra with striaal punctures larger and more densely placed than those of the interstrial spaces .......................................................... 2
   Elytra with striaal and interstriaal punctures equal or nearly so in size and density, coarse and confused on dorsal area; declivity with interspaces 1 smooth, 3 granulate. In cones of *Pinus ponderosa* and rarely in *P. jeffreyi*; *Ponderosae* Hopk.

2. Elytra with striaal punctures in obscure rows on lateral area ........................................... 3
   Elytra with striaal punctures in distinct rows on lateral area, declivity with interspace 1 smooth. In cones of *Pinus lambertiana*, rare in *P. monticola* .........
       ............................................................... *Lambertianae* Hopk.

3. Pronotum with punctures of posterior area fine .......... 4
   Pronotum with punctures of posterior area coarse; elytra with punctures of dorsal area coarse and impressed. In cones of limber pine, *Pinus flexilis* .......
       .................................................................. *Flexilis* Hopk.

4. Declivity with interspace 1 smooth, except toward the apex; pubescence long.
   Smaller species, length 3.1 mm. in cones of shore pine, *Pinus contorta* .......... 5
   Larger, more robust species, length 3.2 to 3.5 mm. in cones of Western white pine, *Pinus monticola* .................................................. *Monticola* Hopk.

**Conophthorus ponderosae** Hopkins 15:431

"Length 3.50 to 3.85 mm.; color black with reddish elytra. Eltryal punctures coarse, impressed; punctures of striae and interspaces of about the same size and density as those of the lateral and dorsal areas; declivity not strongly impressed, striae 1 not punctate, 2 and 3 faintly punctate, and 3 with distinct granules."

(Fig. 78.)

Type locality: Ashland, Oregon.
Distribution: Oregon, California, and Colorado.
Hosts: *Pinus ponderosa*, rarely in *Pinus jeffreyi*.
Habits and work: Miller (15:1 to 8) gives an account of this species. The beetles usually attack cones of ponderosa pine in their second year of growth, when the cones are 1 to 1½ inches long. In a few cases they have been found attacking first year cones, but in such cases eggs are not deposited and no brood develops. Attacks are usually made in May and by mid-July this brood has matured and the newly emerged adults are infesting new cones, where they overwinter. The adult enters the cones by boring through the scales near the base. Such entrance tunnels may be located by the small pitch tubes and red borings and frass collected about the entrance. The tunnel is a spiral around the axis of the cone to cut off its nourishment and then the egg tunnel is...
excavated directly out through the central axis of the cone. Unlike the attacked sugar pine cones, those of ponderosa pine remain on the tree.

*Conophthorus contortae* Hopkins 15:432

"Length 3.1 mm.; shining blackish-brown. Declivity with interspace 1 smooth, except near the apex, pubescence long. Very similar to *C. monticolae*."

Type locality: Newport, Oregon.
Distribution: Western Oregon.
Hosts: *Pinus contorta* cones.

Like *C. ponderosa* the beetles enter directly through the cone and they and their larvae destroy a large part of the interior, including all the seeds, before they reach maturity.

*Conophthorus monticolae* Hopkins 15:432

"Length 3 to 3.5 mm. Clothed with long, conspicuous, bright red hairs; pronotum coarsely asperate; the elytra coarsely and deeply punctured; the interstrial punctures less numerous on the disk, usually 7 to 10 between the declivital summit and the base of the elytra; declivity broadly, distinctly sulcate, suture without granules."

Type locality: Priest River, Idaho.
Distribution: British Columbia to Oregon, east into Idaho.
Host: Cones of *Pinus monticola*.

The habits are similar to the other species given.

*Conophthorus flexilis* Hopkins 15:433

"Length 3.15 mm. Black, dull not shining; posterior area of pronotum coarsely punctate. Elytral punctures coarse and impressed on the dorsal area, placed in obscure rows on lateral area; these are smaller and less densely placed than on the dorsal area. Declivity with striae 1 not punctured, 2 and 3 approximate and faintly punctured, interspace 3 with very obscure granules."

Type locality: Mount Manitou, Colorado.
Distribution: Colorado and Idaho.
Host: *Pinus flexilis* cones.

*Conophthorus lambertianae* Hopkins 15:433

"Length 3 to 4 mm. Black, shining; elytra with striae punctures in distinct rows on lateral area; punctures of interspaces smaller and more sparsely placed than those of the striae, especially so laterally. Declivity with interspace 1 smooth, striae 1 without punctures, interspace 3 with granules."

Antenna is shown in figure 15.

Type locality: Hilt, California.
Distribution: California and Oregon: Probably occurs throughout the range of its host tree.
Host: Sugar pine, *Pinus lambertiana*.

Habits and work: This species works in a manner differing from that of species which work in cones which are sessile. Sugar pine cones have rather
long stems which will be 2 to 3 inches long on second year cones. It is during the second year of growth that the cones are most subject to attack.

The beetles bore into the stalk, usually near the cone and this results in a flow of resin, which forms a small pitch tube. The tunnel turns and runs directly through the axis of the cone. Egg niches, accommodating a single egg, are excavated at intervals and from 15 to 30 eggs are deposited in a large cone. Sawdust and borings are packed in the gallery as the female progresses. The species is monogamous since each gallery is occupied by a single pair and only one pair attacks any individual cone. The attack stops growth of the cone and unlike the attack on ponderosa pine cones, those of the sugar pine fall to the ground. The principal period of emergence and attack is late May and early June. Late in the season these parent adults will be found dead in the cones near the end of the gallery.

Larvae work out irregularly from the egg gallery and feed on developing seeds and scales. They grow rapidly and pupate in about one month. The drying cones fall to the ground where the pupae change to adults. These adults do not emerge at once, remaining in the fallen cones for the rest of the summer and over the winter, emerging the next May or June. One full year is required for a complete cycle.

From 50% to 90% of the cones in restricted areas may be attacked.

27 Genus MYELOBORUS Blackman 28:16

This genus is closely related to Pityophthorus and also to Conophthorus. It is similar to the latter in general body form and antennal characters, but differs in other respects, notably in the pronotal characters. In antennal characters Myeloborus closely resembles Pityophthorus. This resemblance is also evidenced in the strongly developed ninth elytral interspace.

Characters: Moderately stout body form; pronotum with dorsal outline not evenly convex, transversely impressed behind the summit, anterior margin serrate, asperities extending behind the middle at the sides; ninth interspace of elytra usually strongly elevated; front of head convex, usually with longitudinal carina, stronger in male; antennal club not more than one-fifth longer than funicle; narrower in male, sutures 1 and 2 not septate.

There are 8 described species, 2 named by Swaine and 6 by Blackman. So far as known, all species work in the twigs of Pinus. Species whose biology is known have very similar habits which are as follows:

Habits and work: Attack is usually made on the underside of living, healthy twigs, the beetles boring into the pith where a few eggs are deposited in niches along the sides. A pitch tube usually forms around the entrance tunnel. The larvae work out more or less irregularly, destroying the wood and killing the twig. It is customary for the newly-transformed beetles to remain in the twigs and feed for a considerable time before emerging to attack.

The killing of numerous twigs may be of importance in the case of small trees, but on older trees it is more likely to be of distinct benefit by bringing about a more rapid pruning, resulting in a better grade of lumber.
Three species of this genus are found in the Northwest but are extremely rare in this area. The writer has not seen any specimens collected in the Northwest.

Key to Species of MYELOBORUS in the Northwest
(Modified after Blackman)

1. Antennal club similar in both sexes; segments 1 and 2 together as long or longer than 3 and 4 combined; front of head without longitudinal carina in the female, sometimes very weak in the male ...........................................PINQUIS Blkm.
   Antennal club of female wider than in the male, segments 1 and 2 together shorter than 3 and 4 combined; front of head with longitudinal carina, more evident in the male .................................................................2

2. Small species, less than 2.3 mm. long; with elytra only slightly wider than the pronotum which has blunt serrations on the anterior margin, punctures on the posterior area fine, granules distinct ...........................................CATULUS Blkm.
   Larger species more than 2.5 mm. in length, with elytra distinctly wider than the pronotum which is broadly rounded in front, posterior area strongly granulate-punctate ..........................................................BOYCEI (Sw)

Myeloborus pinquis Blackman 28:20
Stout, black, length 2 mm. Front convex, slightly flattened; deeply, coarsely, roughly punctured. Antennal club 1.18 times longer than wide (fig. 79); segments 1 and 2 together, longer than 3 and 4 combined, sutures slightly curved. Pronotum slightly wider than long; anterior margin with 6 to 9 small, acute teeth; asperities small and numerous; posterior area deeply punctate, more densely at the sides. Elytra wider than pronotum; disk shining, slightly rugulose; strial punctures moderately fine, deep in approximate rows; interspaces with few punctures; declivity gradually rounded; sulcus wide and shallow; suture slightly elevated, with faint trace of granules near apex; first and second striae impunctate, third slightly elevated with faint trace of granules, ninth moderately elevated on the sides; there are a few long hairs on the sides of the declivity. Foretibia as shown in figure 79.

The male is shorter, broader; front more coarsely and roughly punctured. Type locality: Longmont, Colorado.
Distribution: Colorado, New Mexico, Arizona, and Idaho.
Hosts: Pinus flexilis and P. strobiformis.
This is a southern species but has been taken in the extreme southern part of Idaho.

Myeloborus catulus Blackman 28:21
Black, with front area of pronotum reddish-brown; robust; length, 2.1 mm. Front convex, finely, roughly punctured with a poorly developed denticle on the epistoma; hairs fine, short, and inconspicuous. Antennal club broadly oval, first suture nearly straight, second weakly arcuate, third nearly obsolete; pronotum as wide as long; anterior margin roughly serrate; anterior area as-
perate and lighter in color; posterior area granulate-punctate, with a smooth, elevated, median carina. Elytra slightly wider than pronotum; surface densely, confusedly punctured near the scutellum; striae in somewhat regular rows of moderately spaced, medium-sized punctures. First stria distinctly impressed behind the middle, others not impressed; interspaces sparsely punctured, ninth strongly convex behind the middle; declivity oblique; suture elevated, narrow, finely granulate; second interspace strongly sulcate; lateral elevations prominent with fine granules on the third interspace; first and second striae becoming obsolete on the declivity. Last ventral segment widely emarginate. Male more coarsely, roughly punctured on the front with an evident longitudinal carina.

Type locality: Clark's Ford, Idaho.
Distribution: Idaho and Wyoming.
Host: Pinus, probably P. ponderosa.

*Myeloborus boycei* (Swaine) 25:192
Described as *Pityophthorus boycei*.

This is one of the largest species of the genus, length being nearly 3 mm. Color dark fusco-piceous with pronotum lighter; front convex with moderate punctures and few fine hairs below; distinct longitudinal carina; antennae yellow, club 1.2 times longer than funicle and one-fifth longer than wide, first two segments narrow, forming less than one-half the club length; first suture nearly straight, second weakly arcuate, third strongly so. Pronotum scarcely longer than wide, posterior line weakly arcuate; sides scarcely constricted before the middle; anterior area strongly serrate, moderately asperate, irregularly arranged. Elytral striae with small, very shallow punctures, arranged in fairly definite rows; interspaces wide, with a few scattered, nearly obsolete punctures; declivity arched, with moderately wide and shallow sulcus; sutures moderately elevated with obsolete granules; first and second striae punctures obsolete; lateral elevations with a row of very fine granules in the third interspace, ninth elevated especially posteriorly where there are a few minute granules.

Type locality: Placer County, California.
Distribution: California and Oregon.
Hosts: *Pinus contorta* and *Pinus ponderosa*.

The species was collected by H. E. Burke at Joseph, Oregon (Blackman).

28 Genus *PSEUDOPITYOPHTHORUS* Swaine 18:93

Small slender species; antennal club with distinct, strongly arcuate sutures, distal segments much wider than the basal one; tibia coarsely serrate; elytra not striate, punctures sparse to dense in more or less regular rows.

The genus contains eleven North American species which use broad-leaved trees as hosts, the majority attack various species of *Quercus*.

A single species is found in the Northwest.
Pseudopityophthorus pubipennis (Le Conte) 60:59

This species was described under the name Bostrichus pubipennis by Le Conte and subsequently was transferred to Tomicus (1860), Cryphalus (1868), and Pityophthorus 1876, all by Le Conte. Swaine placed it in the present genus in 1918.

In addition to generic characters given above, the disk of the pronotum is moderately shining, rather closely punctured, and with very short hairs; elytra quite densely punctured and pubescent; declivital hairs shorter and less abundant.

Type locality: San Jose, California.

Distribution: Along the Pacific Coast from British Columbia to California in the range of the native oaks.

Hosts: Various species of Quercus.

This is the only bark beetle commonly found in oak in our territory. It often attacks oak cordwood in great numbers and if such material is moved into the home the emerging broods are often present in terrific numbers. Such a situation may cause considerable concern to the householder who fears they may do damage to the woodwork in the home. Such worry is unfounded since the beetles attack only where bark is present.

Galleries are confined to the inner bark and do not engrave the wood. The egg tunnel is horizontal, usually extending an equal distance from each side of the turning niche and entrance tunnel which are above and below the egg tunnel (fig. 81); each branch is normally about three-fourths of an inch in length. Egg niches are in softer portions of the bark and the maximum number of eggs noted was 88, with a minimum of 10 and an average of about 41. Larval mines are also in the softer portions of the bark and run with the grain of the wood. They vary from \( \frac{1}{2} \) to 1 inch in length. Pupation takes place in cells in the inner bark.

Fig. 81. Gallery of Pseudopityophthorus pubipennis
29 Genus PITYOPHTHORUS Eichhoff 64:39

This genus contains the greatest number of species of Scolytidae belonging to any genus found in North America. The species are small in size and in many cases are so closely allied as to make identification very difficult. For a rather complete discussion of the genus and for a full description of most of the species, the reader is referred to Blackman's paper (1928), "The Genus Pityophthorus Eichh. in North America."

Earlier described species of this genus were classified under the generic name Bostrichus in Europe, while in America Crypturgus and Cryptalus were used. Le Conte (1876) recognized Pityophthorus but included many species later placed in Gnathotrichus Eich. (1868), Pseudopityophthorus Swaine (1918), Pityoborus Blackman (1922), and one species was later made the type of the genus Conophthorus by Hopkins (1915).

All of the above, as well as the genus Myeloborus Blackman (1928) and Pityophilus Blackman (1928), form a group conveniently referred to as the tribe Pityophtorini.

Our species of the genus Pityophthorus proper, are all small, cylindrical, elongate; reddish-brown to black in color. The head is more or less hidden in the pronotum; eyes are emarginate on the inner line. The antennal club (fig. 82) is about one-half longer than wide, with sutures 1 and 2 septate; asperities of the pronotum not extending behind the middle; body pubescent; elytra sparsely punctured and pubescent; declivity quite strongly sulcate; female with numerous long hairs on the front of the head, those of the male shorter and less numerous.

For the most part the species are twig and branch miners and although the majority attack coniferous hosts, a number are found in broadleaf trees. The majority are found in the west. The following table shows the distribution, and hosts:

| Western species | 72 | Coniferous feeders | 88 |
| Eastern species | 31 | Broad-leaf feeders | 9 |
| West and East   | 5  | Hosts unknown     | 11 |
| Total species   | 108 | Total            | 108 |

So far as recorded the species are all polygamous and in many cases the galleries (figs. 86 and 87) are very much alike. A typical gallery consists of a more or less oval to round, small, nuptial chamber from which radiate a varying number of female egg galleries.

For the most part the species are of minor economic importance, although occasionally a species (P. confinis, P. confertus, etc.) may kill young trees or tops of older healthy trees. The great majority confine their work to limbs and twigs of dying, injured, or felled trees, or suppressed branches. In fact, in many cases they may be considered beneficial, killing suppressed limbs and thus hastening natural pruning, working in slash and opening up such material to the entrance of water and wood-destroying fungi, thereby hastening the slash disintegration and reducing the fire hazard.
Blackman divides the genus into seven groups as given below. No species belonging to Group I or Group II have been reported from this area.

Blackman’s Key to Groups of PITYOPHTHORUS in North America

1. Body form appearing flatter and with the ninth interspace more strongly elevated; antennal club with first segment notably narrower than the others, widest through the third segment; segments 1 and 2 together, notably shorter than 3 and 4 together ........................................ GROUP I, no species of this group are found in this area.

2. Elytra with punctures of striae 1 and 2 not strongly reduced on the declivity; second interspace not widened; small species ........................................ 2

3. Declivity strongly sulcate, striae 1 and 2 not strongly reduced on the declivity; strongly developed on the declivity ........................................ GROUP II, no species of this group are found in this area.

4. Elytra very broadly to narrowly rounded behind, not acuminate; front of head in both male and female variously modified ........................................ 5

5. Front of head longitudinally carinate in both sexes, the carina stronger in the male, declivity not deeply sulcate ........................................ GROUP IV, page 149

6. Front of head in male longitudinally carinate, that of female finely pubescent or with moderate to long hairs; antennal club with first suture at least weakly, the others more strongly arcuate ........................................ GROUP V, page 150

The writer is not convinced that all of the forms recognized by Blackman (1928) as distinct species are valid, but until more biological work is carried out, his findings are used here.

As mentioned above, 79 of the 110 species occur in the western states, and 22 of these have been reported from the Northwest, but a few of the records may be somewhat questionable.
GROUP III. A single species of this group is reported from this area.

*Pityophthorus albertensis* Blackman 28:50

Length 1.58 mm.; front coarsely, sparsely punctured, flattened below, with fine, short hairs; antennal club as shown (fig. 82). Declivity sloping, suture weakly sulcate, scarcely elevated and without granules, punctate, and with a row of very short hairs; first and second striae finely punctured; lateral convexities slightly elevated, not granulate. Allied to *opaculus* but separable by shape and sculpture of the pronotum.

Type locality: Banff, Alberta.

Distribution: Alberta and British Columbia.

Host: *Pinus contorta*.

Fig. 82. Antennal club of *Pityophthorus albertensis* (After Blackman)

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Key to Species of GROUP IV in the Northwest

1. Front of head in female with a fine longitudinal carina, slightly stronger in male, stria punctures moderately fine, rows somewhat irregular, interstrial punctures similar and numerous; declivity with punctures of striae 1 and 2 greatly reduced but not obsolete ................................................................................................................. *idoneus* Blackm. Frontal carina in female evident only just above epistomal margin, male carina very strong and toothlike; stria punctures coarse, in regular rows, those of interspace not so numerous; declivity with punctures of striae 1 and 2 only slightly reduced ............................................................................................................................................. 2

2. Larger species (2.2 mm. or more) declivity rather deeply sulcate, suture strongly elevated .......................................................................................................................... *smithi* Schedl. Smaller (1.7 mm.) and more slender; declivity rounded, sulcus very shallow, impunctate, suture slightly elevated ........................................................................................ *ponderosae* Blackm.

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*Pityophthorus idoneus* Blackman 28:55

Female dark reddish-brown, 2 mm. long; front closely and finely but roughly punctured; strongly elevated longitudinal carina up from epistomial margin.

Similar to *ponderosae* but larger, stouter, and more coarsely punctured.

Declivity more sloping than in *ponderosae*, sulcus wide.

Type locality: Centerville, Idaho.

Distribution: Taken at several localities in Idaho.

Not reported from any other area of the Northwest.

Host: *Pinus ponderosa*. 
Pityophthorus ponderosae Blackman 28:57

Female dark reddish-brown, 1.7 mm. long; front plano-convex below, finely and roughly punctured with a distinct, narrow, elevated carina extending from the broadly emarginate epistomal margin to a level above the upper angles of the eyes. Pronotum slightly wider than long, anterior margin with numerous, small, low serrations, anterior area with irregular concentric rows of rather coarse asperities. First elytral striae slightly impressed back of middle, others not impressed, interspaces finely rugulose with fine punctures. Declivity rounded, sulcus moderately wide, very shallow, shining, impunctate, suture slightly elevated.

Type locality: Los Vegas Hot Springs, New Mexico.

Distribution: Arizona, New Mexico, and British Columbia.

Host: *Pinus ponderosa*.

This species is included here since G. Stace Smith reports collecting it at Copper Mountain, British Columbia (det. by Schedl).

Pityophthorus smithi Schedl 31:163

Length 2.37 mm. Front flattened on a semicircular area below, finely, moderately closely, punctate, with fine, inconspicuous hairs (female); longitudinal carina distinct but not strongly developed; antennal club with first suture straight, second feebly arcuate, third strongly so. Pronotum with numerous low serrations on anterior edge; asperities low, in nearly regular concentric rows. First elytral striae distinctly impressed, others not at all; punctures in regular rows and moderately coarse; interspaces moderately wide, punctures similar to those of striae. Declivity rounded, fairly deeply sulcate, suture rather strongly elevated, with numerous retuse granules, punctures of first striae nearly obsolete, second visible but greatly reduced; lateral convexities moderately high, with rather strongly developed retuse granules. Male with well-developed, elevated, laterally compressed, toothlike longitudinal carina.

Type locality: Copper Mountain, British Columbia.

Host: Twigs of *Pinus contorta*.

Not reported from any other locality.

Key to Species of GROUP V in the Northwest

1. Stout species; antennal club oval, widest through the second segment, sutures arcuate; elytra with punctures reduced on the lateral convexities, granules of sutures rather feebly developed; hairs small and inconspicuous; longitudinal carina of male strongly developed above only ........................................... *Confinus* Lec.

   More slender species; longitudinal carina on front of the male, fully developed .... 2

2. Strial punctures very fine; declivital sulci very shallow, moderately wide; granules on suture and lateral convexities very minute ........................................... *Demissus* Blkm.

   Strial punctures coarser; declivital sulci deep; granules on lateral convexities fine to moderately coarse; pronotum sparsely punctured behind; anterior margin with 6 to 8 sharp serrations ........................................... *Venustus* Blkm.
Pityophthorus confinus Le Conte 76:354

Female, length 3 mm.; piceous; coarsely, confusedly sculptured, the pubescence sparse and fine on the sides, almost invisible on the disk.

The front is densely, deeply, and rather coarsely punctured above, with a flattened, somewhat semicircular area in front, densely, finely punctured, and clothed with long reddish-yellow hair; the antennae as shown (fig. 83). The pronotum is about as wide as long, sides straight and parallel on more than the caudal half, then constricted and broadly rounded in front; the front margin moderately serrate; asperities of the cephalic half moderate in size and subconcentric; closely punctured behind; more coarsely on the disk, with a smooth median line. The elytra have the sides nearly straight and subparallel, moderately narrowed, and broadly rounded behind; the punctuation coarse, close, and deep, decidedly confused on the disk, with the surface strongly roughened, punctures much smaller behind (near the declivity); the declivity broadly and rather strongly sulcate, the suture feebly elevated and finely granulate; lateral convexities each with two rows of fine granules and fine setae. The male has the front convex, coarsely, closely punctured, impressed and more finely punctured on the epistoma, almost glabrous, with a strongly developed, longitudinal, acute, median carina, less elevated on the epistoma, and the declivity rather more deeply sulcate.

Type locality: California.

Distribution: British Columbia to Arizona and New Mexico in the Rocky Mountains, and Pacific Coast regions. The species is fairly common in all the Northwest.

Hosts: Pinus ponderosa, P. lambertiana, P. jeffreyi.

Salman (38:613) found Pityophthorus confinus and P. confertus killing the tops of virgin ponderosa pine in various parts of California in 1935 and 1936. Attacked trees were, in some instances, largely on cutover lands, although on other areas the attack was on virgin timber. The Pityophthorus attack was primary, but in many cases was followed by Dendroctonus brevicomis and other scolytid attack.

P. confinus attacks twigs, tops of trees, reproduction, trees in the pole stage or even trunks of mature trees. It may be primary or it may follow the attack of other species.
Pityophthorus demissus Blackman 28:74

Female usual color; 1.77 mm. long, front with moderately long, incurved, yellow hairs; closely, roughly punctured above, Strial punctures of the elytra very fine, in definite rows; interspaces wide, finely rugulose, with a few fine punctures; declivity weakly sulcate; lateral convexities low, with a few, very minute granules.
Type locality: Glacier National Park, Montana.
Host: Abies lasiocarpa.

Wood reports collecting this species in Utah within a few miles of the Idaho border, and with topography, climate, and flora the same across the line, it undoubtedly also occurs in Idaho.

Pityophthorus venustus Blackman 28:75

Length (female) 2.05 mm. front flattened below, with moderately fine, long hairs, longer above. Antenna as illustrated (fig. 84). Strial punctures deep, rather fine, and close; declivity with narrow moderately deep sulci; suture weakly elevated, with a few fine granules.
Type locality: Kaibab National Forest, Arizona.
Distribution: Arizona and New Mexico. It is also reported from British Columbia by G. Stace Smith.

Hosts: Pinus ponderosa, P. contorta, and Abies concolor.

Apparently a common species in the mountains of Arizona and New Mexico, its occurrence in British Columbia in lodgepole pine would seem questionable. Specimens collected at Creston were determined by Schadl.

Fig. 84. Antenna of Pityophthorus venustus (After Blackman)
Key to Species of GROUP VI in the Northwest

1. Pronotum rather narrowly rounded in front with median serrations distinctly longer; frons of the female smooth, devoid of pubescence except for a fringe of long, coarse, incurved hairs about the margin; elytral declivity with well developed granules on suture and lateral convexities in both sexes ............................................. TUBERCULATUS (Eich.)

Pronotum moderately to broadly rounded in front, with the median serrations not noticeably longer than the others ........................................................................................................ 2

2. Frontal pubescence in female erect; sides of pronotum distinctly constricted in front of middle; declivital sulcus deep and wide ............. INTEXTUS Sw.

Frontal pubescence in female sparser and much shorter in the middle area ........ 3

3. Elytra with strial punctures fine, regular, and close; the declivital sulcus rather wide and shallow, lateral convexities not strong; interspaces very sparsely punctured ........................................................................................................ PSEUDOTSUGAE Sw.

Elytra with strial punctures coarser; declivital sulcus narrower and deeper, with lateral convexities strongly to very strongly developed; punctures of the interspaces sparse to fairly numerous .................................................. NITIDULUS (Mann.)

Pityophthorus tuberculatus Eichhoff 178:498

P. rugicollis Swaine (25:193) is a synonym or possible variety.

P. australis Blackman (28:94) is a synonym.

Length, 1.7 mm. to 2.3 mm. It has frontal characters of the nitidulus group, with small elytral punctures and widely sulcate and coarsely granulate declivity; the declivity is less broadly rounded behind than usual, with the suture more strongly developed, so that the declivital characters are intermediate between nitidulus and pullus. See Blackman (28:92-94).

Type locality: California.

Distribution: South Dakota west to the Pacific Coast States, south into Arizona, New Mexico, and Texas.


Blackman finds that this species shows great variation and considers P. rugicollis Swaine as a variety or a synonym of tuberculatus.

The species is often very abundant in this territory and has been reported from many hosts. It is often found at high altitudes.

Fig. 85. Antenna of Pityophthorus tuberculatus (After Blackman)

Pityophthorus intextus Swaine 17:29

Length 1.8 mm.; pronotum very broadly rounded on the front margin and only feebly serrate; elytral interspaces sparsely punctured; the declivity rather narrowly rounded at the apex, and broadly sulcate; the female front densely clothed with short hairs on a circular, convex area; declivity with
suture and lateral convexities distinctly granulate; sulcus prominent with long bristlelike hairs.
Type locality: British Columbia.
Distribution: Alberta to British Columbia. Also taken in Oregon.
Hosts: *Larix occidentalis*, *L. lyallii*, and *Picea engelmannii*.

*Pityophthorus pseudotsugae* Swaine 18:100

Female dark reddish-brown; length, 1.9 to 2.1 mm. Closely allied to *tuberculatus*; of the same size, shape, and secondary sexual characters; but differing in having serrations on the front margin of the pronotum numerous and only very slightly larger at the middle line, strial punctures usually regular, and the declivity with sparsely placed and generally small granules on the lateral convexities, and minute granules on the narrower, less elevated suture.
Type locality: Vernon, British Columbia.
Distribution: British Columbia south through the Pacific Coast and Rocky Mountain States.
Hosts: *Pseudotsuga menziesii*, *Abies lasiocarpa*, *A. grandis*, *A. concolor*, *A. magnifica*, and *Picea engelmannii*.

This is a rather common species throughout its range. It works in twigs and small limbs, making the typical radiate gallery (fig. 86) so common to species of this genus.

*Pityophthorus nitidulus* (Mannerheim) 43:298

Described as *Bostrichus nitidulus* by Mannerheim and referred to *Cryphaus* by Le Conte (68:156).

*Pityophthorus (Cryphaus) atratulus* (Le Conte) (68:156) is a synonym. Swaine (18:100) also places *P. (C.) puncticollis* (Le Conte) (74:71) as a synonym.
Length from 2.0 to 2.4 mm. This species differs from its near allies in having the punctures of the elytra rows much finer and more closely placed, and intervals wider and more even. The prothorax is also distinctly rounded on the sides, and slightly constricted near the tips. Antennae and feet are dark brown; front clothed with long hairs, prothorax longer than wide. Male: head flat; punctured, not opaque, clothed with long erect yellowish hairs. Female: head less hairy; elytra more retuse behind.

Blackman (28:109) finds, after studying a large series, that specimens from pines are smaller, more finely and regularly punctate, and show other differences. California specimens compared with Le Conte's types of *P. atratus* and *P. puncticollis* were found to agree quite closely.

Type locality: Sitka, Alaska.

Distribution: Alaska south through western Canada and the Western States to California and New Mexico.


The work (fig. 87) consists of a small central chamber under the bark, from which 3 or 4 galleries radiate. There are 3 or 4 females and 1 male in each chamber, each female having her own gallery in which to deposit eggs. The minute eggs are placed in slight niches and covered with frass. Larvae work out in all directions, and pupate in a cell almost wholly in the bark. When mature they eat their way directly to the surface.

This species is said to have been observed flying in great numbers in spruce regions of Colorado, where it does considerable damage.

It is also reported at an altitude of 11,000 feet in the Los Vegas Mountains of New Mexico. It is quite common in the Northwest.

Fig. 87. Gallery of *Pityophthorus nitidulus*
Key to the Species of GROUP VII in the Northwest

1. Elytral punctures varying from slightly irregular (especially in the males) to confused; interstrial punctures at least moderately numerous ........................................ 2
   Elytral striae punctured in regular rows; interspaces without punctures or very sparsely punctured ................................................................. 5

2. Declivity strongly sulcate, with first and second striae distinctly punctured; pronotum only slightly longer than wide, sculpture coarser ........................................GRANDIS Blkm.
   Declivity moderately to very strongly sulcate, with punctures of striae 1 and 2 much reduced or obsolete ................................................................. 3

3. Elytral punctures strongly confused at least near the suture ........................................ 4
   Elytral punctures not strongly confused, more or less irregular. Pronotum only slightly longer than wide; front of head in the female with rather sparse, very fine hairs, longer and in-curved around the margin ................................BURKEI Blkm.

4. Elytral declivity with sulci very deep, lateral convexities very strongly and abruptly elevated, closely and strongly serrate along the summit ..................................................SERRATUS Sw.
   Elytral declivity with sulci moderately deep, lateral convexities not so strongly or abruptly elevated, less closely granulate along the summit ................................CONFERTUS Sw.

5. Pronotal asperities not fused to form continuous concentric ridges; apex of elytra acuminate; frons of male with transverse carina ........................................ 6
   Pronotal asperities fused to form continuous, or nearly so, concentric ridges; apex of elytra subacuminate; declivity very steep, sulcus very deep and strongly widened behind; lateral convexities strongly elevated .....................................VIRILIS Blkm.

6. Body at least 3 times as long as wide in the females .................................................. 7
   Body less than 3 times as long as wide in both sexes .................................................. 8

7. Front of head in female finely and densely punctured on an area of more than a semicircle; ornamented with long hairs, much longer at sides and behind; frons of male with an arcuate transverse carina ........................................GRACILIS Sw.
   Front of the female's head very finely and densely punctured below, on a semi-circular area of limited width, and ornamented with short to medium-long recumbent hairs. Front of head in female ornamented with extremely short hairs ...........................................MURRAYANAE Blkm.

8. Body larger; pronotum slightly longer than wide, widest near the middle; males with lateral elevations of declivity abrupt and the summit strongly granulate-serrate ..............................................BASSETTI Blkm.
   Body smaller (1.5 to 2 mm.); pronotum distinctly longer than wide, widest behind the middle; striae punctures finer, males with lateral convexities of declivity less abrupt, summit not serrate, granules smaller and sparser ........................................ 9

9. Pronotum rather narrowly rounded in front, the front margin rather strongly serrate; striae punctures coarser and deeper, interspaces narrower and more strongly rugulose, apex of elytra weakly acuminate ...........................................CUTLERI Sw.
   Pronotum broadly rounded in front, the front margin scarcely serrate; striae punctures fine, interspaces wider and smoother; elytral apex more strongly acuminate ................................ELECTUS Blkm.
Pityophthorus grandis Blackman 28:119

Length 2.2 to 3.2 mm.; front transversely impressed below, deeply, closely punctured, with moderately sparse, short hairs. Antennae as illustrated (fig. 88); elytra strongly, confusedly punctured, with posterior end strongly acuminate; declivity oblique; sulcus deep and wide; suture wide, strongly elevated with a row of coarse granules.

Type locality: Kaibab National Forest, Arizona.

Distribution: Arizona, Black Hills of South Dakota, and reported from British Columbia. There is a large series in the Hopping collection labeled Midday Valley, British Columbia, determined by Blackman.

Host: Pinus ponderosa.

Pityophthorus serratus Swaine 18:103

Regarding this species, Blackman (28:122) says:

"This species seems to be quite closely allied to P. confertus Sw. The body is of about the same size and proportion; the front of the head similar to confertus in both male and female; the sculpture of pronotum somewhat coarser; and declivital sulci deeper with the lateral convexities more abruptly elevated, and their summits closely serrate with coarser granules. The writer has not seen a type specimen, but would suggest that this form may be a variety or an extreme variation of P. confertus Sw.

"The species was originally described from specimens taken from yellow pine, Siskiyou County, California."

The status of this species is questionable. It has been reported from British Columbia and undoubtedly occurs in Oregon and Washington.
Pityophthorus burkei Blackman 28:129

Female 1.94 mm. long. Closely allied to *comptus*, but distinguished by the front of the head (female) not being strongly or widely flattened, less closely punctured and pubescent; pronotum less broadly rounded, transverse impression less developed, punctures coarser and sparser; elytral punctures coarser and the declivital sulcus wider, the apex not so acute.

Type locality: Meyers, California.
Distribution: Oregon, Idaho, Utah, and California.
Hosts: *Pinus contorta* and *P. ponderosa*.

There is a series of specimens and samples of work (fig. 89) of this species in the Forest Insect Laboratory at Portland, taken from *Pinus contorta* at Beatty, Klamath County, Oregon.

Fig. 89. Gallery of *Pityophthorus burkei* (U.S. Forest Service photograph)
**Pityophthorus confertus** Swaine 17:27

Length 1.9 to 2.6 mm. The female (fig. 90) with the front subcircularly plano-concave, closely and very finely punctured, closely pubescent with rather long yellow hairs, longer about the margin, with a faint median line; male with the front flattened, semicircularly margined by a subtriangular callus behind; closely, deeply, not coarsely punctured, pubescence short and subequal in length. Declivity deeply, broadly sulcate, suture moderately wide, elevated and finely, sparsely granulate, (quite variable).

Type locality: Adam's Lake, British Columbia.

Distribution: British Columbia to California, east into Idaho and Colorado.

Hosts: *Pinus contorta, P. edulis, P. monticola, P. lambertiana, P. ponderosa; Abies grandis; and A. concolor.*

This species is quite common in the pine regions of the Pacific Coast States where it attacks slash and often works in limbs of living trees. It is reported (Salman 38:615) to attack tops and even main trunks of thrifty ponderosa pine in California.

Fig. 90. Adult and antenna of *Pityophthorus confertus*
Pityophthorus virilis Blackman 28:143

Length (female) 1.66 mm. Front ornamented with long hairs; coarsely and roughly punctured above the nearly circular flattened area. Pronotum slightly longer than wide; anterior margin with 10 to 12 low, blunt serrations; declivity very steep, deeply sulcate, strongly retuse; suture narrow and moderately elevated above, higher and wider below; granules coarser below.

Male larger (1.87 mm. long).

Type locality: Vermego, New Mexico.

Distribution: Colorado, New Mexico, and Idaho.

Host: Rhus copallina.

Specimens of this species have been taken by Wood in southern Idaho.

Pityophthorus gracilis Swaine 25:195

Pityophthorus exilis Sw. (25:196) is a synonym.

The female is reddish-brown; 2.2 mm. long; front of the head with a subcircular area of hairs, longer behind; the pronotum broadly rounded in front, the asperities broad and low on the anterior area, posterior area moderately punctured, with the median line elevated toward the summit; elytra have the strial punctures moderately coarse, deep, in regular rows; declivity moderately sulcate with very small granules on suture and lateral convexities.

The male is slightly stouter with stronger punctuation on both pronotum and elytra, the declivity with the sulcus deeper; suture and lateral convexities more strongly elevated and with coarser granules.

Type locality: Grant County, Oregon.


Host: Pinus contorta.

Pityophthorus murrayanae Blackman 22:139

P. elongatus Swaine (25:194) is a synonym (vide Blackman).

P. tenuis Swaine (25:196) is a synonym (vide Wood).

The adult female is reddish-brown; 2.2 mm. long; front finely, densely pubescent; pronotum with broad, flattened serrations on edge; asperities, broad and low. Declivity strongly sulcate, striae 1 and 2 with punctures barely evident; suture wide, elevated; granulate; lateral elevations moderate with few minute granules, scanty short hairs.

Type locality: Grand Lake, Colorado.


Host: Dying bark of Pinus contorta.

Pityophthorus bassetti Blackman 20:1

Length 2.2 mm. (male); reddish-brown; female, 2.4 mm. long. Front with a distinct
elevated transverse carina; pronotum slightly longer than broad, widest at the middle, broadly rounded and slightly serrate in front; acute asperities in regular concentric rows on anterior half of pronotum. Elytra parallel-sided, strongly rounded at base; strial punctures moderately deep; declivity steep, with deep, wide sulcus; suture wide, elevated, with several coarse granules near apex; lateral elevations with sharp serrate edge, armed with 10 to 12 moderately sized black teeth, each with a stiff tactile hair arising from its inner base.

Female differs in being larger, with front slightly concave and having a densely punctured and pubescent circular area. Teeth on declivity replaced by granules.

Type locality: Pitkin, Colorado.

Distribution: Colorado and Idaho.

Hosts: *Picea engelmannii* and *Abies balsamea* (Bred from the latter in the laboratory.)

This species breeds under thin bark and if the attack is on bark sufficiently thick the miners will scarcely touch the cambium. The gallery consists of an entrance tunnel running diagonally upward with an irregular nuptial chamber at its base. From the chamber 4 to 9 egg galleries are excavated. These start from various points around the nuptial chamber, but quickly assume a general longitudinal direction and vary from 3½ to 7 centimeters in length. Egg niches are widely spaced, averaging about 12 per inch.

*Pityophthorus cutleri* Swaine 25:195

The female is 2.0 mm. long, slightly less than three times as long as wide, the elytral apex acuminate; front of head in the female plano-convex, very finely and densely punctured, ornamented with long yellow hairs; pronotum with sides arcuate on the posterior half, constricted before the middle, rather narrowly rounded and moderately serrate in front, posterior area moderately punctured; elytra with strial punctures of moderate size, rather close, in regular rows, interspaces very sparsely punctured; declivity rather broadly, moderately deeply sulcate-retuse, with suture and lateral convexities finely granulate.

Type locality: Midday Valley, Merritt, British Columbia.

Host: *Pinus ponderosa*.

Not reported from any other locality.

*Pityophthorus electus* Blackman 28:140

Female reddish-brown, 2.81 mm. long; head flat, finely, closely punctured with long hairs. Anterior margin of pronotum with 6 to 8 small serrations, longer near the middle; elytral strial punctures deep, close, quite fine and in regular rows. Declivital sulcus shining, deep and quite narrow; suture narrow, moderately elevated with numerous fine granules; lateral convexities strongly elevated with a row of quite fine granules in the third interspace.

Type locality: Ashland, Oregon.

Host: *Pinus ponderosa*.

No other information available on this species.
Species of this genus have been treated under a variety of generic names, chiefly *Tomicus* Latr. (07:27) and *Bostirichus* Fab. (76:59).

*Ips* is one of the larger genera and many species are primary enemies of our forest trees. There is considerable variation within the species and with approximately 30 recognized names in North America, doubtless some of them are synonyms.

**DESCRIPTION OF THE GENUS Ips**

The body varies from moderately slender to rather stout; it is cylindrical, and 2 to 8 millimeters in length. Color ranges from brown to black. The sculpture is rather strong, the pronotum strongly asperate in front, and punctured behind. The elytra is concave on the declivity, and the concavity is separated from the apical margin by a definite horizontal platelike extension distinct from the elytral margin. The antennal club (fig. 92) is flattened, with definite sutures on the outer face. The intercoxal process on the pronotum is long and acute.

The species are polygamous and although there is considerable variation in the galleries there is usually a central nuptial chamber and 3 to 8 radiating egg galleries.

Usually the species are secondary, breeding in dying and felled trees, in logs and slash; at times they emerge from such materials in great numbers and attack living trees. Such infestations are usually of short duration.

Species of *Ips* breed in coniferous trees and are well represented in the Northwest where 18 species have been reported. The validity of one of these, *interpunctus*, is questionable. Not all species of coniferous trees are attacked. *Picea* is the host of 18 species, *Pinus* is attacked by 9 species while *Abies*, *Larix*, and *Pseudotsugae* have been reported as hosts of one species each. The latter three genera of trees may be considered as more or less accidental hosts.

**Key to Species of IPS in the Northwest**

1. The sutures of the antennal club very strongly arcuate, not angulate at the middle nor bisinuate; the punctures of the elytral striae and interstriae very closely uniseriate 2

   The sutures of the antennal club nearly straight, bisinuate or strongly angulate at the middle 3

2. Caudal half of the disk of the pronotum granulate, the interstrial punctures of the elytra smaller or equal to those of the striae; declivity somewhat excavated and the sides more strongly elevated than the suture .......................... *Concinus* (Mann.)
Caudal half of the disk of the pronotum, rather coarsely punctured, not granulate; the interstrial punctures as large as those of the striae, the elytra coarsely punctured

 chuckled

3. The declival margin with 5 or 6 teeth on each side; the produced apical margin forming much less than one-third of the circumference

4. The declival margin with less than 5 teeth, usually 4, rarely 3

5. Rather finely sculptured; the pronotum finely and rather sparsely punctured behind, the median line smooth and finely impressed; the interstrial punctures of the elytral disk much smaller than those of the striae, and sparse; the punctures of the declival cavity sparse; the pubescence on sides of pronotum and elytra sparse and rather short, at the declivity sparse and hardly longer than the teeth; smaller, 4 mm. to 4.5 mm. long

6. The third declival tooth the longest, compressed, wide, emarginate at the tip; the discal interspaces impunctate; the conical fourth tooth usually obsolete, large species 6 to 7 mm.

7. Declivity oblique, with four teeth on each side, the third usually the longest

8. Declivity with three slender, conical, sharp, slightly incurved teeth, the first directed caudad mesad, the second longer and incurved, third slightly longer than second and directed caudad

<table>
<thead>
<tr>
<th>Species</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>I. radiatae</td>
<td>Caudal half of the disk of the pronotum, rather coarsely punctured, not granulate.</td>
</tr>
<tr>
<td>I. confusus</td>
<td>Very coarsely sculptured; the pronotum coarsely, closely punctured behind, the median line very narrow and feebly convex.</td>
</tr>
<tr>
<td>I. montanus</td>
<td>Declivity nearly vertical with three teeth on each side; the interstrial punctures small except near the declival margin.</td>
</tr>
<tr>
<td>I. emarginatus</td>
<td>Declivity with three slender, conical, sharp, slightly incurved teeth, the first directed caudad mesad, the second longer and incurved, third slightly longer than second and directed caudad.</td>
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</tbody>
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**Radiatae Hopk.**

**Confusus (Lec.)**

**Montanus (Eich.)**

**Emarginatus (Lec.)**

**Guilbii Blkm.**
Declivity with three teeth, the first is small and acute, second broad and composed of the confluence of three cusps, third long and acute, none are curved. \textit{Latidens} (Lec.)

8. The sutures of the club very strongly angulated at the middle, beetles of large size and coarse sculpture. \textit{Plastographus} (Lec.)

The first suture of the club bisinuate or nearly straight, the second more or less strongly bisinuate or angled at the middle. \textit{Interpunctus} (Eich.)

9. The discal interspaces impunctate except near the declivity, rarely punctured on the first and second. \textit{Interpunctus} (Eich.)

All the interspaces punctured, uniseriately except near the declivity. \textit{Oregoni} (Eich.)

10. Larger species 4 to 5.5 mm. stout; first two interspaces granulate-punctate, hairy to the base. \textit{Perturbatus} (Eich.)

Smaller, more slender species; first two interspaces not granulate and hairy to the base. \textit{Interpunctus} (Eich.)

11. The pronotum widest at the base, slightly arculate on the sides, the punctures coarse and the asperities more commonly sparse and obtuse; elytral striae usually distinctly impressed and the interspaces convex. \textit{Interpunctus} (Eich.)

The pronotum with sides parallel on more than the caudal two-thirds, punctures and asperities usually small, close and acute; the elytral striae hardly impressed except the sutural one. \textit{Oregoni} (Eich.)

12. The front of the head densely, finely granulate, the strial punctures usually close and of medium size. \textit{Interruptus} (Mann.)

The front of the head very coarsely granulate, with abundant long hairs. \textit{Borealis} Sw.

13. The front of the head almost perfectly smooth and polished, minutely and sparsely granulate and pubescent in the male; the epistomal region never more than faintly elevated; usually less than 4 mm. long. \textit{Borealis} Sw.

The front of the head densely or coarsely granulate with abundant long hairs or distinctly elevated on the epistomal region. \textit{Interpunctus} (Mann.)

14. Front of head evenly convex. \textit{Interpunctus} (Mann.)

Front of head very coarsely granulate. \textit{Borealis} Sw.
15. The punctures of the elytral striae of medium size and usually widely separated... *DUBIUS* Sw.
The punctures of the elytral striae very coarse, quadrate, and very closely placed; very coarsely sculptured... (male) PILIFRONS Sw.

16. Front of the head enormously elevated and a nearly naked geminate prominence on the epistomal region... *TWIDENS* (Mann.)
Front of the head only moderately elevated... 17

17. Front of the head usually with a strong brush of hairs
Front of head without a brush of hairs, merely pubescent... *YOHOENSIS* Sw.

18. The brush composed of straight erect hairs;
small 3 to 3.5 mm. long... *SWAINELI* R. Hop.
The brush composed of short extremely dense hairs resembling the pile on velvet. Larger, 4.5 mm. or more in length... (female) PILIFRONS Sw.

*Ips concinnus* (Mannerheim) 52:358 The Sitka Spruce Engraver
This insect is 4.5 to 5 mm. in length, rather elongate, parallel sides. Sutures of the antennal club are very strongly elongate-arcuate, strongly but very narrowly recurved at the sides. The elytra is shining, hardly striate, finely and deeply punctured in numerous rows, the interstitial punctures nearly as large and numerous as those of the striae. The declivity is nearly vertical, excavated, densely and deeply punctured and pubescent.

Type locality: Alaska.
Distribution: Alaska south along the Pacific Coast into northern California.
Hosts: *Picea sitchensis*, rarely in *Pseudotsuga menziesii*.

Habits and work: The entrance tunnel penetrates to the cambium where an irregular central chamber is excavated, engraving both bark and wood. From this nuptial chamber each of the associated females digs her own egg tunnel. Usually 3 to 5 females are working out from each central chamber. The egg tunnels are short and curved with 3 or 4 eggs deposited in each egg pocket.

According to Dr. Wood (correspondence) *Ips chamberlini* Sw. is a synonym of *I. concinnus*. The former has been found only in Douglas-fir and is the only species of the genus reported from that host. The writer is not convinced that it is the same as *concinnus* but until work is done on the biology, we are following Wood's suggestion.

*Ips radiatae* Hopkins 15:34 The Monterey Pine Engraver
This insect is 4 to 5 mm. in length, brown to black in color. The sides are parallel, and there is a very prominent spine on each wing cover. Hairs on the face of the declivity are minute and inconspicuous. The male front is densely granulate with the median fovea very deep and funnel-shaped, similar...
to *I. plastographus* and *I. concinnus*. It differs by the characters given in the key and may be separated from *I. concinnus* by the coarser prontal and elytral punctures. In the field the species are easily separated by the pattern of the galleries. Type locality: Berkeley, California. Distribution: British Columbia to Southern California, east into Idaho and Wyoming. Hosts: Monterey, Bishop, knobcone, lodgepole, Jeffrey, and whitebark pines. Hopping (1950) reports taking this species from *Pinus flexilis* in Waterton National Park, Alberta. Habits and work: This species usually attacks injured, dying, or recently dead trees. The primary gallery is usually “U” or “S” shaped (fig. 93) and instead of niches, egg pockets are excavated and 3 or 4 eggs placed in each pocket so that 3 or 4 larval tunnels have a common starting point, giving the complete tunnel an appearance quite different from most other species found associated with it. When two females are present each female usually cuts a gallery in the opposite direction from the other, making a combined S-shaped gallery. The egg pockets, 2 to 2½ mm. deep, 1½ to 2 mm. wide, and ½ mm. apart, are nearly all cut on the outside bend of the gallery, so that the young larvae will not interfere with one another in procuring enough food to last them through their larval stage. Larvae cut their mines directly out from the egg gallery.

Fig. 93. Adult and gallery of *Ips radiatae* (By Edmonson)

Fig. 94. *Ips radiatae*, male, left; female, right (After Trimble)
The single egg gallery, combined with the numerous larval mines, effectively illustrates the name “engraver beetle” by making the fantastic fan-shaped engraving on the sapwood. Pupal cells average 7 by 5 mm. (Trimble 24:382).

There are three generations in California (Keene 38:117), and winter is passed as adults and larvae in trees killed during the summer. Although this species is ordinarily a secondary pest, found associated with other species, at times it becomes primary and presents a problem calling for extensive control operations. Such infestations have been found to have their origin in slash. It is sometimes a serious enemy in nurseries and plantations.

_Ips confusus_ (Le Conte) 76:362 The California Five-Spined Engraver

Described as _Tomicus confusus_.

A reddish-brown to nearly black species, 4 to 4.5 mm. long; pronotum sparsely and rather finely punctured behind the middle, more closely at the sides; interstitial punctures of the elytra smaller than those of the striae; the declivity with five teeth on each side; the first tooth about as near the suture as to the next tooth; face of the declivity covered with fine hair.

Type locality: California.

Distribution: California, Oregon, Washington, and Idaho. Hopping reports the species from British Columbia.

Hosts: Various species of pine but primarily _Pinus ponderosa_ and _P. lambertiana_. It is found in _P. monticola_, _P. coulteri_, _P. radiata_, and others.

Habits and work: This is a primary species and is responsible for the death of the tops of mature trees, reproduction, and second growth material in the pole stage. The species is polygamous and excavates a central chamber from which the females cut their egg galleries in a more or less longitudinal direction. These usually number 3 to 5 and lie very largely in the bark, scoring the sapwood very lightly. They are commonly 6 to 10 inches long. Each female deposits from 25 to 50 eggs and the larvae mine out at right angles from the egg gallery. These mines lie in the cambium and the pupal cells are excavated almost entirely in the bark.

The life cycle is quite short and there are from 3 to 5 generations per year, depending on locality and seasonal conditions.

Fall generations almost invariably attack standing trees in which the broods will pass the winter. Other generations will attack down material and most of the serious outbreaks which have occurred can be traced to slash and debris. All such material should be burned before the broods emerge.

_Ips montanus_ (Eichhoff) 81:219

_Ips vancouveri_ Swaine (16:188) is a synonym (vide Wood)

This is one of the largest species of the genus, being about 5.5 mm. in length. It is dark reddish-brown in color, the head rather sparsely granulate. Sutures of the antennal club are very strongly angulated at the middle. The
The pronotum is longer than wide, widest at the base. Strial punctures are coarse, close, deep, and quadrate. Five teeth are on each side of the declivity, the second declivital tooth is conical acute, with the caudal margin sinuate and nearly vertical. The elytral declivity is densely clothed with long hairs.

Type locality: of *vancouveri* is Vancouver Island, British Columbia. T. L. of *montanus* is probably Alaska.

Distribution: British Columbia, south into California, east into Montana.

Hosts: *Pinus monticola*, *P. lambertiana*, *P. contorta*, *P. balfouriana*, and *Picea sitchensis*.

Habits and work: Usually a secondary insect working in conjunction with other species of bark beetles, however at times it becomes primary and under favorable conditions will attack and kill healthy trees.

The work (fig. 95) is typical of a number of species of *Ips*, consisting of a central chamber from which 3 to 5 rather long, longitudinal egg galleries extend up and down the trunk.

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*Ips emarginatus* (Le Conte) 76:363 The Large Western Pine Engraver

Described as *Tomicus emarginatus*

This is one of the largest and most destructive species of the genus *Ips*. Length, 6 to 7 mm.; cylindrical, black, sparsely clothed with long yellow hairs. The head is granulated, with two small frontal elevations, the anterior one near the margin, which is usually fringed with long yellow hairs. Prothorax one-half longer than wide, the base broadly rounded. The elytra possess striae composed of strongly impressed transverse punctures. Sutures of the antennal club are nearly straight, slightly bent forward at the sides.
The species is easily distinguished by having the tooth of the fifth interspace very wide, compressed, and emarginate so that the tip is divided into two projections of approximately equal prominence (fig. 97). This is similar to the same tooth in *Ips knausi* but the third tooth of *emarginatus* is much wider, and the fourth tooth nearly obsolete.

Type locality: Oregon.

Distribution: British Columbia into Southern California, east into Idaho.

Hosts: *Pinus ponderosa, P. contorta, P. lambertiana,* and *P. jeffreyi.*

Habits and work: This species is often associated with the various species of *Dendroctonus* and with other species of *Ips* in killing trees. Under favorable conditions it will attack and kill apparently healthy trees without assistance.

During the summer it requires about 10 weeks for this species to attack a tree, raise a brood and emerge. They are polygamous; the galleries straight, longitudinal, and 3 to 4 feet in length. They run side by side and are connected by cross galleries at intervals, giving a ladder-like pattern. The galleries are packed with borings. Larval mines are rather inconspicuous but the pupal cells are large and lie close to the egg tunnels.

*Ips latidens* (Le Conte) 74:72 The Smaller Western Pine Engraver

Described as *Tomicus latidens*

*Ips (Tomicus) spinifer* Eichhoff (78:499) is a synonym.

This is one of the smallest species (fig. 98) in this genus found in the western United States. It is a slender insect, 2.7 to 3.5 mm. in length, and is distinguished from others by nearly straight sutures of the antennal club, and deeply punctate-striate elytra; straighter sides of the pronotum; the declivital armature arrangement; secondary sexual characters, and the short, though acute, apical projection of the declivity (fig. 98). The first tooth of the declivity is small and acute; the second is broad and composed of the confluence of three cusps; third is long and acute followed by an acute apical margin.

Type locality: California.

Distribution: The pine belt from British Columbia into California, east into Idaho. Taken near Klamath Falls, and Ashland, Oregon.

Hosts: *Pinus ponderosa, P. lambertiana, P. jeffreyi, P. contorta, P. sabiniana,* and *P. monticola.*
Habits and work: This species usually attacks dead, dying, or suppressed limbs, although it occasionally attacks weakened trees and kills them. The gallery consists of a rather large central chamber from which 2 to 5 short, and usually curved egg galleries radiate. Eggs are deposited singly in the niches and larval mines are medium long.

*Ips guildi* Blackman 22:137

Color, reddish-brown to black; length 2.7 to 3.5 mm., allied to *I. latidens* and *I. longidens*, but distinguished by the coarser frons, the presence of a carina, and a coarser pronotum armature. The declivity is quite perpendicular, concave with deep punctures, lateral margins prominent, each armed with three prominent, slender, sharp, and slightly incurved teeth (fig. 99); the first arising from the second interspace; the second opposite the third interspace; followed by a ridge with 2 large tubercles (sometimes not prominent or replaced by blunt teeth); third tooth larger and nearly straight.

Type locality: Grand Lake, Colorado.


Host: *Pinus contorta* and *P. ponderosa*.

No data on the biology is available. Oregon specimens were collected in the Blue Mountains.

*Ips plastographus* (Le Conte) 68:163 The California Pine Engraver

Described as *Tomicus plastographus*.

*Ips integer* (Eich.) (69:273) is a synonym.

Length 4.5 to 5 mm. Declivity with 3 rather prominent teeth; the second compressed and closely united with the third. Punctures of pronotum and elytra fine. Third, fourth, and fifth interspaces without punctures except near the declivity. (This character helps separate *plastographus* from *radiatae* in addition to its having only 7 rows of conspicuous elytral punctures [fig. 100] while *radiatae* has 11 rows of elytral punctures.) They are also easily distinguished by the galleries.

Type locality: California. (T. L. of *I. integer* is "Boreal America").

Distribution: California to British Columbia, east into Idaho and Montana.

Hosts: *Pinus radiata*, *P. contorta*, *P. ponderosa*, *P. monticola*, and *Larix occidentalis*.

![Fig. 99. *Ips guildi*](image-url)

![Fig. 99. *Ips guildi* (After Blackman)](image-url)

![Fig. 100. *Ips plastographus*](image-url)

![Fig. 100. *Ips plastographus* (After Swaine)](image-url)
In California this species is reported (Trimble 24:384) to swarm from September to November.

Work: The male starts the gallery and is joined by 2 or 3 females, each of which excavates her individual egg tunnel parallel with the grain of the wood, 1 going up and 2 going down from the nuptial chamber. The chamber is usually somewhat to one side of the main line of the egg galleries, which are kept clean of frass and borings. Egg galleries are almost wholly in the bark, barely scarifying the wood. The egg niches are fairly well separated, and where 2 egg galleries run parallel, very few niches are excavated along the inner margins since the available space between the galleries would accommodate only a few larvae. Egg galleries average about 5 inches in length while larval mines average about 1\frac{1}{2} inches.

Weakened trees are preferred as hosts, but windfalls and larger slash also serve as breeding materials.

Each female deposits an average of 60 eggs, although a maximum of 104 has been observed. The complete cycle, egg to adult, requires 7 to 8 weeks during the warmer part of the year. There are 2 generations in central California.

Johnson (54:431) reports finding adults hibernating in especially constructed galleries in lodgepole pine at a 6,100 foot elevation in Montana. The tunnels were \frac{1}{2} to \frac{3}{8} inch into the sapwood radially and assumed a “C” shape. They arose at intervals along irregular winding galleries which scored the sapwood and inner bark. The adults were newly formed and the trees were windthrows.

_Ips perturbatus_ (Eichhoff) 68:247

Described as a _Tomicus perturbatus._

_Ips (Tomicus) hudsonicus_ (Le Conte) (76:363) is a synonym.

Length 4.7 to 5.5 mm. Distinguished from its allies by the stout form and usually large size (among Eastern species); long, erect, abundant pubescence; short and stout pronotum; the punctuation and pubescence of the first two elytral interspaces; the deep, wide, and posteriorly widened sutural striae; the usually convex interspaces, and the stout, rather short declival armature. The male has the third declival tooth more acutely pointed.

Type locality: Probably Alaska.

Distribution: This species is widely distributed in the Canadian Zone from Newfoundland across Canada to northern British Columbia up into Yukon Territory and Alaska.

Hosts: _Picea canadensis, P. engelmannii,_ and _P. glauca._

Habits: It is apparently confined to the range of white spruce in Canada and Alaska and is reported as an important secondary enemy, at times becoming of primary importance.

_Ips oregoni_ (Eichhoff) 68:274 The Oregon Pine Engraver

Described as _Tomicus oregoni._

_Ips (Tomicus) rectus_ (Le Conte) (76:363) “Is probably an abraded specimen of _Ips oregoni._” (Swaine)
A medium sized species, about 4.5 mm. long, closely related to *pini* but larger and stouter; pronotum as wide as long with the sides straight and parallel, broadly rounded in front, finely punctured behind; elytral striae hardly impressed, second interspace with a row of punctures on the caudal half making the sutural striae evidently widened behind; sides of the elytra rather coarsely punctured. Four small teeth are on each side of the elytral declivity (fig. 101).

**Type locality:** Oregon.

**Distribution:** Throughout the pine region of the far western states and far western Canada. (See note at end of this species.)

**Hosts:** Probably will attack any species of pine available. Reported from *Pinus ponderosa, P. contorta, P. jeffreyi, P. lambertiana,* and *P. sabiniana*.

**Habits and work:** This is the most abundant *Ips* in most of the pine belt in Rocky Mountain and Pacific Coast States. It often breeds to countless numbers in slash and attacks trees in which *Dendroctonus* or other beetles are working. If windfalls, logs, damaged trees, and such materials are not available for the emerging broods they will attack healthy trees. They are apparently unable to maintain their numbers in healthy trees and such epidemics seldom last more than a single season.

By preference, attacks are made where the bark is rather thin. The species is polygamous, and 3 to 5 egg galleries (occasionally more or less) are excavated from a central chamber. These usually run with the grain of the wood and are fairly short, 5 to 10 inches long. During the warmer portion of the season broods develop rapidly with 3, or even 4, generations developing in a single year.

Like *Polygraphus* and a few other species, *Ips oregoni* adults, having deposited one complement of eggs are known to emerge and excavate a second gallery, depositing second, or even third lots of eggs.

**Note:** This species is doubtfully distinct from the common *Ips pini* Say of the East. If this is true, it represents a species of very wide distribution and a number of host trees could be added to those given above. At present it would seem advisable to retain the name *I. oregoni* to designate the western form. See also, remarks under *I. interpunctatus*.

*Ips interpunctus* (Eichhoff) 78:241

Described as *Tomicus interpunctatus*.

*Ips (Tomicus) tridens* (Eichhoff) (68:274). The species referred to by Eichhoff under this name is *interpunctatus, tridens*, being preoccupied by Mannerheim in 1852.

This species is apparently a northern variety of *Ips oregoni* and is also very closely related to, and possibly only a variety of, the eastern species *pini*.

Swaine (18:116) redescribed the species and commented on it as follows:

"Length, 4 mm. to 5 mm.; the head convex and coarsely granulate; the pronotum as long as wide (sometimes slightly longer), usually rather coarsely
and deeply punctured behind, the elytra usually rather deeply striate on the disk, with the interspaces narrow and distinctly convex; the second interspace punctured on the caudal half making the sutural striae widened behind.

"The Jasper race, from Jasper Park region, have the elytral striae more often lightly impressed, except the sutural striae, which are almost invariably wide and deep, and the interspaces more often nearly flat.

"In pine and spruce of southern British Columbia the typical \textit{interpunctus} is less common and is intergraded with the \textit{oregoni} type. The two forms are there taken in the same trees and apparently from the same tunnels. Breeding experiments and biological studies should determine the relationships between these series. Our very large collection from many parts of British Columbia, Alberta, the Yukon, and a smaller collection from the Western States, indicates that \textit{interpunctus} is typically a northern form, tending strongly to vary in Alberta and apparently crossed with \textit{oregoni} in southern British Columbia."

Type locality: North America.
Distribution: A northern species, British Columbia to Alaska and the Yukon, east into Alberta, and south into Oregon, Marshfield, Oregon, Revelstoke and Vernon, British Columbia.


Habits and work: Similar to those of \textit{oregoni} but less aggressive.

\textit{Ips borealis} Swaine 11:213

Swaine's remarks are, "Length, 3.25 mm. to 4 mm.; more slender than \textit{interruptus}; the female with the front and vertex of the head convex, remarkably smooth and polished, with a few extremely minute punctures, the anterior portion of the front and the region about the eyes extremely minutely, more closely punctured and bearing minute inconspicuous hairs; with a very faint, broad, transverse impression between the eyes; the epistoma faintly depressed; the first two sutures of the antennal club broadly bisinuate, the second more strongly; the declivity with four teeth on each side, of the \textit{pini} type, the third tooth but little longer than the second, more cylindric, blunt, and incurved; the male with the front minutely granulate-punctate and hairy, rather closely in front of the eyes, with a very small median tubercle, the granules and punctures usually separated with the background distinct. This is vastly different from \textit{interruptus}, with the front very densely and much more coarsely granulate and hairy, or from \textit{dubius} in which the frontal granules are much coarser than in \textit{interruptus} and isolated. There is considerable variation in the size of the punctures of pronotum and elytra, and in some the elytral striae are distinctly impressed."

Type locality: St. Anthony, Newfoundland.
Distribution: Newfoundland and Nova Scotia across the coniferous forest belt of Canada. Through northern Manitoba, Saskatchewan and Alberta, into British Columbia, and Alaska.
Hosts: *Picea canadensis, P. engelmannii,* and *P. rubens.* It is doubtfully recorded from *Abies balsamea* and *Tsuga canadensis.* Reported by Hopping to breed in *Abies lasiocarpa* in British Columbia. According to Swaine (18:118) it is a secondary enemy of little economic importance.

*Ips interruptus* (Mannerheim) 52:357

Described as *Bostrichus interruptus.*

"The original description and Le Conte's notes are very meager. There are probably four species in the Le Conte collection under this name. The first was probably received from Mannerheim, and fixes the species. Redescribed by Swaine (18:118), "The length varies from 4 to 5 mm.; the head has the front rather coarsely punctured above, very densely, finely granulate and closely hairy on the cephalic half, the granulate portion strongly convex, a transverse impression behind the epistoma, succeeded by a small median fovea; the pronotum slightly longer than wide, rather coarsely and sparsely asperate in front, usually coarsely, not closely, punctured behind; the elytral striae slightly impressed, the sutural striae wide and deep, regularly widened behind the strial punctures, moderate in size and closely placed; the discal interspaces moderately convex, rather finely and uniseriately punctured; the declivital armature of the male *pini* type, with the third tooth stouter than the second and blunt in the female; the male has the third tooth coarser and capitulate, and the front a little more coarsely granulate."

Type locality: North America, probably Alaska.

Distribution: Oregon to Alaska along the Pacific Coast. Marshfield, Oregon, and Revelstoke, British Columbia.

Hosts: Sitka spruce (*P. sitchensis*) and white spruce (*P. canadensis*).

*Ips engelmanni* Swaine 17:30

*Ips dubius* Swaine (18:119) is a synonym (vide Wood).

This species is very similar to *tridens* in characters of the pronotum and elytra, although the punctures are usually more pronounced and the striae more impressed; the front of the head is evenly convex and coarsely, sparsely granulate, the epistoma slightly, transversely impressed, the median line smooth towards the vertex, less roughened than the sides, and is shining cephalad to the epistomal impression. It is separated from *interruptus* by the same characters and by sparser elytrial punctures; in *interruptus* the front is usually very densely, finely granulate, with elytral punctures small and close. Regarding this complex Swaine states: "The forms here discussed as *tridens, engelmanni* and *dubius* are taken in the same sticks and even together in the same tunnels. This may be due, as is indicated elsewhere, to the wandering of late feeding young adults, or it may be that *dubius* is the male of *engelmanni,* or less probably of *tridens.* *I. pilifrons* Sw. is closely allied to *engelmanni,* and has a somewhat similar frontal structure; the form taken with *pilifrons* and described by the writer as probably the male, differs from

* This assumption is now verified by Wood.
*Ips yohoensis* Swaine 17:31

This species is closely related to *tridens*. Swaine (18:120) points out that frontal characters will serve to distinguish the two. In this species the front is very finely and densely granulate and finely pubescent on the cephalic half. It is slightly, but distinctly, elevated transversely behind the epistoma, which is broadly and triangularly impressed medially, immediately in front of the elevation; the epistomal margin and the median impression bear long yellow hairs; the elevation is more evidently pubescent than the remainder of the granulate part of the front, with a trace of a smooth median line. Punctuation of the pronotum is usually coarse and close; elytral striae are usually deeply impressed and coarsely punctured with sparser interstrial punctures nearly as large as those of the striae. The male has the front somewhat longer and more evidently capitate.

Type locality: Yoho Valley, British Columbia.
Host: *Picea engelmannii*.

No other data on this species is available.

*Ips swainei* R. Hopping 39:169

Length 3 mm., head black, epistomal area slightly elevated, with a moderately dense brush of erect hairs, the area behind the brush smooth, shining and inconspicuously, sparsely punctate. Antenna with club nearly round, pale yellow except the basal segment which is shining brown, sutures bisinuate. Pronotum slightly longer than wide, roughened as usual in front, sparsely punctured and shining behind, with a shallow, median sulcus.

Elytra with striae moderately impressed and large punctures, interspaces comparatively wide, from the first to the fourth with a few scattered punctures. Marginal half of the elytra rather coarsely, confusedly punctured. The elytral declivity sparsely, irregularly punctured, with three teeth equally distant from the basal margin, the middle tooth slightly larger than the others.

The color varies from light to dark brown, head black and sparsely covered with rather long hairs.

Female differs from the male only in having the front of the head lacking the brush and epistomal elevation, the front being evenly convex and conspicuously, sparsely punctured.

Type locality: Creighton Valley, Lumby, British Columbia.
Host: *Picea engelmannii*. 
**Ips pilifrons** Swaine 12:353

Length, 4.5 to 5 mm. Front with a brush of short, dense pile. First suture of the antennal club bisinuate to nearly straight, second more or less angled at the middle. Pronotum hardly longer than wide and strongly punctured on the disk. The front of the head densely or coarsely granulate, or distinctly elevated on the epistomal region, and evenly convex. Punctures of the elytral striae are very coarse, quadrate, deep, and very closely placed. The insect is very coarsely sculptured.

Type locality: Colorado.
Distribution: Northern Rocky Mountain Region, Colorado to Idaho and British Columbia.
Host: *Picea engelmannii*

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**31 Genus PITYOGENES** Bedel 88:397

The species are moderately stout with scanty pubescence; prothorax very strongly asperate in front and punctate behind; elytra punctate-striate; declivity moderately excavated and with two prominent teeth (fig. 103), more prominent in the male. The antennal club is flattened with sutures on both sides.

Of the 7 North American species, 3 occur in our territory.

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**Key to Species of PITYOGENES in the Northwest**

1. The declivity oblique; pronotum strongly narrowed on more than the cephalic half, and narrowly rounded in front; the declivity of both sexes with three small teeth on each side, considerably larger in the males. Frontal pit of the female circular and undivided. Length 2.3 mm. .................................................**Fossilrons** (Lee.)

2. Rather stout species; the frontal cavity of the female very large, extending behind the eye, not divided; the acute ridge preceding the second declivital tooth of the male strongly developed .................................................**Carinulatus** (Lee.)

3. Rather slender species; the frontal cavity of the female heart-shaped in front of the eyes and divided. The ridge preceding the second declivital tooth in the male feebly developed .................................................**Knechteli** Sw.

The species are polygamous and excavate a central nuptial chamber where 3 to as many as 10 females may be associated with one male.
Pityogenes fossifrons (Le Conte) 76:353

Described as Pityophthorus fossifrons.

Length, 2.3 mm.; black, with the declivity red. Front of the female is granulate about the sides, with the excavation very large and deep, occupying nearly the whole cephalic half; the pronotum much narrowed in front, coarsely, moderately closely, and regularly punctured behind, with a narrow median carina; the elytral punctures are in approximate rows, the strial punctures fine and rather close, the interspaces rather more closely and finely granulate-punctate, the pubescence behind, short and fine; declivity with a row of three small teeth on each side, sulcate along the sutures.

Type locality: British Columbia.

Distribution: British Columbia to California and east into Idaho. Midday Valley in *P. monticola* and Adams Lake, British Columbia in *P. ponderosa* (Hopping).

Hosts: *Pinus monticola*, *P. contorta*, and *P. ponderosa*.

Apparently a rare species, usually of minor importance though attack on white pine reproduction is recorded (Keen 38:118). Galleries (fig. 102) are of the usual star type with 4 to 5 egg galleries from 1 to 1½ inches long.

Pityogenes carinulatus (Le Conte) 74:70

Described as Cryphalus carinulatus and later (1878) transferred by Le Conte to *Pityophthorus*.

*P. hamatus* Le Conte is a synonym.
This is one of the larger species of the genus, ranging from 2.9 to 3.5 mm. in length. The female has the large deep excavation occupying the central part of the front. The elytral declivity (fig. 103) is very steep, with a row of three small teeth on each side. The male has the front convex, shining. The declivity differs from that of the female, being broadly, shallowly concave, shining, with minute punctures, acutely margined, with two teeth on each side, the upper being long, prominent, slender, and hooked at the tip; the lower one small and acute. The margin also bears a fringe of long stiff reddish hairs.

Type locality: Lake Tahoe, California.

Distribution: Widely distributed from British Columbia and upper Yukon Territory to Southern California in the yellow pine belt.

Hosts: Probably will attack any species of pine within its range. It has been recorded from Pinus ponderosa, P. monticola, P. contorta, P. albicaulis, and P. jeffreyi.

Galleries are of the usual type with a central nuptial chamber from which radiate egg galleries. The number of females associated with each male, as indicated by the number of radiating egg galleries is more than usual for the genus and 8 to 10 females working out from a single central chamber is not uncommon. The individual egg galleries are somewhat longer than those of most other species of the genus, often being 2 inches long. Attack is usually confined to cut tops or limbs, although cases of attack on young trees are known, especially in white pine.

_Pityogenes knechteli_ Swaine 18:106

"Length, 2.8 mm.; rather slender; the front granulate-punctate, convex in the female with a divided median pit preceded by a reddish densely pubescent area; the pronotum emarginate on the sides in front; strongly roughly punctured behind the disk, the median line carinate, the smooth area on the side distinct; the elytra only very feebly striate, punctures in rows, those of
the interspaces nearly as numerous and large as those of the striae; the female declivity feebly convex, deeply sulcate along the suture, with two acute teeth on each side and a minute granule at the summit. The male has the front flattened, densely granulate-punctate and hairy with a small median, epistomal carina." (Swaine).

Type locality: Jasper Park, Alberta.
Distribution: Alberta to British Columbia and south into northwestern United States.
Host: *Pinus contorta*, *P. monticola*, and *P. ponderosa*.

This species excavates nuptial chambers under the thin bark. Three to five females are associated in each gallery and excavate individual egg tunnels out from the central chamber. These range from 1½ to 3 inches in length. They sometimes become sufficiently abundant in slash to emerge and kill young adjacent living trees.

32 Genus PITYOKTEINES Fuchs 11:37

There are three species in this genus, found in North America. The first known American species was described as *Xyleborus sparsus* by Le Conte in 1868. The species has been referred to under the generic name *Tomicus*, *Pityophthorus* (Lec. 1878), and *Pityogenes*. *P. minutus* was described as a *Dryocoetes* by Swaine in 1912. The same author described *elegans* as a *Pityokteines* in 1916.

Description of the Genus:
The front of head is usually clothed with dense yellow hair, club of antennae wider than long, strongly depressed distally, without sutures on the inner face or only at the tip; funicle of five segments; pronotum is not marginal behind; asperate in front and punctate behind. The declivity of the elytra with only faint margins; sutural sulci extend to the apical margin.

The species are small, 1.5 to 2.5 mm. in length, and work beneath the bark of trunks, limbs, and branches of *Abies* and *Picea* and more rarely in *Pinus* and *Larix*. They are polygamous, the mine (fig. 104) consisting of a central chamber from which radiate several (usually 3 to 5) egg tunnels. They are normally secondary pests but occasionally are found killing small trees.

Key to Species of PITYOKTEINES in the Northwest

1. Moderately stout species, with the pronotum very little longer than wide and rather sparsely punctured behind; interspaces of the elytra rather sparsely punctured on the disk, the declival teeth moderate in the females and very coarse in the males ............................................................. 2

Slender species, with the pronotum decidedly longer than wide, and rather closely punctured behind, the interspaces of the elytra rather closely punctured on the disk, the declival teeth small in the males and minute in the females .......................................................... *MINUTUS* (Sw.)

2. The elytral striae finely, regularly impressed on the disk; the strial punctures very closely placed; the interstitial punctures smaller than those of the striae ....

................................. *ELEGANS* SW.
**Pityokteines elegans** Swaine 16:182

Closely allied to *sparsus*, but more elongate, with elytral striae finely, regularly impressed, and interstriae punctures very small. Length, 2.5 mm.; front flattened, densely, finely granulate and densely clothed with very long incurved hairs. Pronotum with front margin broadly rounded; frontal area closely asperate; apical margin with a fringe of dense, very long, orange hairs. Sutural striae deeper and wider than in the others; declivity steep, shining, with scattered strong punctures; rather deeply and broadly sulcate at each side.

Type locality: Hood River, Oregon.

Distribution: British Columbia to California usually in the high mountains.


This species usually attacks tops and limbs of dying or cut trees. The galleries (fig. 104) are similar to the other species.

**Pityokteines minutus** (Swaine) 12:352

Described as *Dryocoetes minutus* Swaine.

**Pityokteines jasperi** Swaine (16:181) is a synonym.

A small, slender species (fig. 105) having the elytra very closely, regularly, deeply punctured.

Female: Length, 2.3 mm., nearly black, with antennae and legs paler. Front of head slightly convex, densely and finely granulate, with a small median tubercle, thickly clothed with very long, curved yellow hairs. Pronotum distinctly longer than wide, with the sides straight on the basal half, broadly, evenly rounded in front; coarsely, rather densely and irregularly asperate in front; rather coarsely and deeply punctured behind; sparse long hairs about the sides and in front. Elytra elongate, sides parallel beyond the middle, striae narrowly, faintly impressed, sutural striae distinctly deeper and wider, punctures of medium size and deep. The declivity is steep, convex, with the suture elevated and sutural striae strongly impressed; declival teeth reduced to three minute, acute granules on the second, third, and sixth interspaces; declivity closely and deeply punctured.

Male: Front slightly convex, densely, deeply granulate-punctate, with an indistinct median carina, sparsely hairy; declivity concave from the deeply,
widely impressed sutural striae, sparsely and deeply punctured, second and third teeth large, acute, first tooth minute, second curved.

Type locality: Colorado.

Distribution: Reported from California, Oregon, Washington, and British Columbia. It probably occurs in Idaho since it is known from Wyoming and Colorado.

Hosts: *Abies lasiocarpa*, *A. concolor* and *Pseudotsuga menziesii*.

Habits and work: The species is widely distributed but rare except in certain favored localities where it occurs in abundance. In northern Klamath County, Oregon, a number of Douglas-fir trees from 5 to 7 inches in diameter were found dying from the work of these beetles. When examined on June 3, the broods were mature and ready to leave the tree. They occurred in such vast numbers that in spite of their small size the bark of the trees was honeycombed from top to bottom. Small pieces of bark removed, exposing 4 or 5 square inches, would reveal from 75 to 125 beetles.

33 Genus ORTHOTOMICUS Ferrari 67:44

*Neotomicus* Fuchs 11:38 is a generic synonym

Hagedorn (1910) includes these species in the genus *Ips*. Blatchley and Leng likewise place *caelatus* (Eich.) under *Ips* and none of these authors mentions *Orthotomicus*. *O. caelatus* was described by Eichhoff in 1867 as *Tomicus* and later was assigned to *Xyleborus* and then to *Ips*. *O. vicinus* was described as a *Xyleborus* by Le Conte in 1874. *O. lasiocarpa* and *O. ornatus* were described by Swaine in 1916 in the present genus. *Orthotomicus lasiocarpa* Swaine has been made the type of a new genus, *Orthotomides* by Wood.

Description: The species resemble the smaller species of *Ips* but may be separated by the following characters: the antennal club longer than wide, considerably thicker at the base, obliquely truncate on the outer distal face; the front of the head without long hair in the female, which separates the species from those belonging to *Pityokteines*; declivity not deeply concave, with the concavity bordered posteriorly by an acute, distinct, apical margin which is not so strongly produced as in *Ips*.

Three species of the genus are reported from this area; however, the status of *O. vicinus* is uncertain.

Key to Species of ORTHOTOMICUS in the Northwest

1. The second visible segment of the abdomen shorter than third and fourth combined, stout species, over 2.5 mm. long; elytral striae strongly impressed; the strial punctures rather coarse and very close; interstrial punctures deep and uniseriate. Hosts, various species of pine

   - *caelatus* (Eich.)

The second visible segment of the abdomen as long as third and fourth combined, smaller, more slender species usually less than 2.5 mm. long.
2. Strial punctures rather small and only moderately close; interstrial punctures very small on the disk, becoming more numerous and nearly as large as those of the striae near the declivital margin; declivital face finely punctured. Hosts, spruce, larch, and rarely pine. 

Strial punctures very close and moderately in size, the interstrial punctures small, larger and granulate toward the declivity; the declivity decidedly concave and strongly punctured, coarsely toothed, the second and third teeth very coarse in the male. Hosts, pines.

Orthotomicus caelatus (Eichhoff) 67:402
Described as Tomicus caelatus Eichhoff.

Tomicus xylographus of Fitch (58:726) is a synonym.

Tomicus decretus of Eichhoff (67:402) is a synonym.

The adult beetle (fig. 106) is reddish-brown to black in color; 2.3 mm. to 3.3 mm. long, and 2.8 times as long as wide. The front of the head is convex above, transversely depressed below, strongly granulate, and with a rather faint longitudinal carina; pronotum densely asperate on more than the anterior half, strongly, deeply, and rather closely punctured posteriorly; elytral striae impressed, deeply and coarsely, and closely punctured, the interspaces deeply, uniserially punctured, with those near the declivity nearly as coarse and numerous as on the striae; the declivity is concave, coarsely punctured, with three teeth at each side, the second and third coarser and not on the lateral margin which is more or less coarsely granulate or tuberculate and is not sharply elevated. The declivity of the male is more concave and the armature is coarser.

Type locality: Unknown to the author.
Distribution: Canada south through the United States to Florida and Mississippi. (See O. vicinus) Hopping reports this species from Alberta.

Hosts: Various species of pine (P. strobus, P. palustris, and P. taeda) also in Larix laricina and Picea.

Habits and work: O. caelatus breeds principally in the thicker bark at the base of the trunk in southern pines. It is never found far from the ground and is therefore most common in stumps of cut trees and in lowermost portions of trunks of standing trees. It may occur in any region of the thicker-barked portion of the trunk of felled trees lying on the ground.

The beetles are polygamous and the general character of the burrows is similar to those of the various species of Ips and other allied genera. They do, however, differ in several important particulars. Egg galleries are short, from 2 to 6 eggs are deposited in a pocket rather than a single egg in a niche and the number of pockets is small. Engravings made by a single brood are therefore smaller in extent, but because of the larger number of larvae within a more limited area, destruction of the bark by the larval mines is more complete.
Blackman says, “This beetle is not usually an important primary enemy of trees although it is able to breed successfully in sappy bark such as that on the stumps of recently cut trees and to resist the flooding of its burrows with pitch. It should, however, be classed as a rather important secondary enemy in that it often attacks weakened trees and completes their destruction, and in concert with other bark beetles attacks and kills apparently healthy trees.”

Orthotomicus vicinus (Le Conte) 74:72
Described as Xyleborus vicinus.
This species is doubtfully distinct from caelatus according to Swaine who points out that there is probably one species of wide range, the eastern form being caelatus and the western vicinus.
Type locality: British Columbia.
Distribution: Oregon, Washington, and British Columbia. Also found in the Rocky Mountains region, east to Manitoba. Although we have no definite records, it doubtless occurs in Idaho.
Hosts: Spruce, larch, and lodgepole pine.
The habits are very similar to those discussed under O. caelatus.

Orthotomicus ornatus Swaine 16:185
Closely allied to caelatus.
Elongate, 2.3 mm. long; front of head convex, closely, coarsely granulate; hairs long but sparse; antennal club similar to caelatus in shape, with first suture recurred, apical segments almost completely telescoped showing only one suture on the upper surface; pronotum longer than wide, coarsely, sparsely, asperate and finely granulate in front. Elytral striae, straight, narrow, regular, and slightly impressed; suttural striae a little wider and more strongly impressed, not widened on the declivity; punctures quadrate-regular, and very closely placed on the striae; declivity vertical, slightly concave, less so in the male, densely, coarsely punctured and hairy, with three teeth on each elytron; the first minute and situated on the second interspace, the second coarse, stout at base, acute, incurved, situated on the third and fourth interspaces, the third small, slender, and straight.
Female has the front closely, coarsely, granulate-punctate, with a tubercle at center; declivity less deeply concave; second and third teeth alike, small conical, and acute.
Type locality: Williams, Arizona.
Distribution: Oregon, California, British Columbia, and Arizona.
Hosts: Pinus ponderosa, P. jeffreyi, and P. contorta.
This species usually attacks near the base of the tree in thick bark.
34 Genus ORTHOTOMIDES Wood 51:32

Antennal club subcircular, slightly wider than long, thickened at base, flattened distally, not obliquely truncate; three sutures on anterior face, the first segment occupying the basal half; posterior face with two sutures, the first segment subcircular, occupying the basal two-thirds; similar to *Pityogenes*. Apical margin of declivity broadly rounded, not acute as in *Orthotomicus*. Declivity subsulcate, armed with small pointed granules in both sexes, similar to female *Pityogenes*.

Allied to *Orthotomicus*, from which it differs by characteristics of the antennal club and declival apex, and to *Pityogenes*, from which it differs by the longer intercoxal process, absence of frontal pit in the female, and absence of prominent declival teeth in the male.

*Genotype—Orthotomicus lasiocarpa* Swaine.

*Orthotomides lasiocarpa* (Swaine) 16:183

Described as *Orthotomicus lasiocarpa*

A small species, 2 mm. long, slender, front convex, deeply, rather coarsely punctured, with a wide median carina. Antennal club slightly longer than wide, obliquely truncate on the distal half, sutures procurred; pronotum slightly longer than wide, numerous, nearly concentric asperities on the front area; strial punctures of the elytra small, moderately close and deep; interstrial punctures nearly the same as those of the striae. Declivity convex, sutural striae deep and widely sulcate. The declivity with denticles in the female, developed into small acute teeth in the case of the male.
THE SCOLYTOIDEA OF THE NORTHWEST

Type locality: Roger's Pass, British Columbia.
Distribution: British Columbia east into Alberta.
Hosts: The thick bark of dying *Abies lasiocarpa* and *Larix americana.*

35 Genus ANISANDRUS Ferrari 67:24

This genus is very closely related to *Xyleborus* and is represented in the Northwest by a single species which is distinguished by the short stout body; the male is only about one-half as large as the female, is humpbacked and without functional flying wings.

*Anisandrus pyri* (Peck) 17:205

There has been considerable confusion regarding this species. It was described as *Scolytus pyri* by Peck and has been treated under the genus *Xyleborus* in American literature. It is very closely related to the European *Xyleborus dispar* Fab. and has been discussed under that name in this country.

The species is small, females (fig. 109) are 2.7 to 3.2 mm.; males 2.0 to 2.1 mm. and distinctly humpbacked in form. The color is black with yellowish appendages. Pronotum with transverse rows of short tubercles in front. Elytra striate, intervals finely punctured and pubescent, the seventh acutely elevated toward the tip.

Type locality: Massachusetts.
Distribution: Widely distributed in the United States and Canada, common in the fruit-growing areas of the Northwest.
Hosts: The insects attack most species of common fruit trees and some 20 other broadleafs. In Oregon it has been taken from elderberry and wild rose, cultivated filberts and English walnuts, in addition to various orchard fruit trees. Reports of this species attacking pine, cedar, and other coniferous trees are undoubtedly in error.

Attack is usually on sickly or weakened trees, especially newly set orchards, trees slightly injured by freeze, sunscald, high water table, and poor soil, or trees rendered unhealthy from other causes. At times it appears to attack normal fruit trees. The gallery differs with the size of the plant at the point of attack. In small trees or small branches it is likely to be a spiral gallery, usually running corkscrew fashion around the limb and up from the point of attack. Side galleries run up or down the stem from this spiral gallery; these are usually short, less than one inch long, all are stained black. Branch galleries may be, and usually are, on the same horizontal plane with the main tunnel.

This is an ambrosia beetle and all stages feed upon the fungi grown in the galleries.
There is considerable confusion in this group since the various species are difficult to separate and since Xyleborus, Xyleborinus, Anisandrus, and Ambrosidmus are not well differentiated. Most of our species have been treated under two or more generic names. Some of the common species have been considered to be conspecific with European forms.

Since the species have been confused, hosts are likewise confused and many trees cited in literature as hosts cannot be relied upon.

Three species, X. arbuti Hopk., X. xylographus (Say), and X. scopulorum Hopk., have been reported from the Northwest. Wood (in correspondence) is of the opinion that there is only one species definitely known from the Northwest. All specimens from this territory have been referred to X. saxeseni Ratzburg which is the same as the European species of that name.

Hopkins (15:60) characterizes the genus as follows, based upon his examination of the genotype (X. monographus Fabricius).

"Antennal funicle 5-jointed, joint 5 short and broad; club short, broad, anterior face obliquely truncate, with one or two recurved sutures, posterior face without sutures; pronotum longer than broad, with sides parallel or slightly narrowed toward the base, apical margin broadly rounded, without serrations; eyes elliptical, emarginate."

*Fig. 110. Adult Xyleborus saxeseni*

**Xyleborus saxeseni** Ratzburg 37:167

**Synonyms:**

- Xyleborus aesculi Ferrari (67:22)
- X. decolor (Boieldieu) (59:473)
- X. dryographus Ferrari (67:20)
- X. subdepressus Rey. (83:142)
- X. arbuti Hopkins (15:64)
- X. xylographus Say of same authors
- Xyleborinus librocadri Swaine (34:205)
- X. tsugae Swaine 34:204

"Female elongate, blackish or brownish-piceous, almost shining, thinly clothed with pale pubescence. Thorax oblong, smooth behind. Elytra feebly punctate-striate, intervals uniseriately punctulate, tuberculate behind; apex declivous almost rounded, pruinose; suture and intervals 3 and 4 uniseriately crenately tuberculate, second subsulcate, smooth. Length, 2 to 2.5 mm. Male shorter, brown-testaceous, with longer pubescence, convex, subdepressed. Length, 1.5 mm."

(Eichhoff).

"Elytral interspaces faintly rugose and subopaque, declivity with interspace 2 not strongly impressed, and interspace 1 not strongly elevated, punctures of striae 1 and 2 obscure." (Hopkins).

**Type locality:** Europe.
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Distribution: Widely distributed in the United States. Hosts: *Quercus, Fagus, Betula, Acer*, and other hardwoods. It also occurs in many coniferous trees if the synonymy indicated above is correct.

The tunnels show considerable variation. In oak the tunnels penetrate through the bark and into the sapwood where a rather large cave is formed. Figure 111 shows a typical tunnel (of *X. libocedri*), as found in incense cedar. After penetrating rather deeply into the wood the mine makes a turn of 90° and the caves are smaller and more numerous than in oak.

The work indicates that this may be a valid species. The larvae and young wander about in the tunnels. The entire surface of the walls of these chambers is plastered with ambrosia fungus, consisting of short, erect stems, terminating in spherical conidia. The brood chamber is packed at times with eggs, larvae, pupae, and adults. The larvae aid in extending the chamber. Great quantities of excrement are sometimes ejected from the openings to the colony, but a portion is retained to form a bed for new crops of food fungus. This species usually attacks dying trees and generally trunks of large size.

37 Genus DRYOCOETES Eichhoff 64:38

Le Conte (68:162) described *D. granicollis* as a species of *Xyleborus* and Mannerheim (43:298) described *septenttrionis* and *semicastaneus* (52:358) as members of the genus *Bostrichus*. They are synonyms with the former of course having priority. In the same publication (52:359), Mannerheim also described *affaber* as a *Bostrichus*. The remainder of our species, named by Hopkins and Swaine were described as members of *Dryocoetes*. 
There are 10 species in our fauna, several of which are of questionable validity. Of these, 4 are found in this territory.

Description of the Genus:

The species are medium small, 2 mm. to 4.8 mm.; cylindrical. Striae punctures of the elytra usually are much larger than those of the interspaces; sutural striae strongly impressed on the disk and declivity.

The antennal funicle has 5 segments, club with or without sutures on the posterior face, and with 1 or 2 procurred to recurved sutures on the anterior face. Anterior margin of the pronotum is smooth; eyes oblong, elliptical, emarginate; tarsi with first 3 segments simple, equal.

The species are found largely in coniferous hosts although some attack birch, beech, or cherry. They are polygamous, from 3 to 6 or even more females being associated with one male.

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Key to Species of DRYOCOETES in Northwest

1. Sutural striae strongly impressed on disk and declivity; very small species about 2 mm. long; strial punctures of elytra much larger than those of the interspaces ................................................................. SECHELTI Sw.

Sutural striae not very widely and deeply impressed on either disk or declivity; larger species well over 2 mm. long .............................................................................................................................. 2

2. Ventral surface with coarse, round shallow punctures; female with front only sparsely hairy; pronotum with punctures more or less obscured by the asperities on the frontal half, rather small and narrower than elytra, strongly arcuate on the sides and strongly narrowed behind and even more so in front. Length 4 mm. or more ............................................................................. SEPTENTRIONIS Mann.

Ventral surface finely punctate, length 4 mm. or less .................................................................................................................. 3

3. The elytral interspaces confusedly punctured on the disk and sides; hairs on front of female, short, straight and forming a dense brush; interstitial punctures noticeably smaller than those of the striae. Length nearly 4 mm. ........ CONFUSUS Sw.

The elytral interspaces rather regularly uniseriately punctured; the front of the female closely hairy, hairs long and rather uneven, not forming a brush; length 3.2 mm. or less ........................................................................................................ AFFABER (Mann.)

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Dryocoetes confusus Swaine 12:351 The Mountain Balsam Bark Beetle

D. abietis Hopkins (15:52) is a synonym.

Length, 3.4 mm. to 4.2 mm., clothed with erect, reddish hairs. The female has the front entirely covered by a circular, very dense brush of short, reddish-yellow hairs, longer about the margin; the declivity has the first two
striae strongly impressed, the strial punctures very small; the first interspace convex, the second less prominent and flattened apically, outer part of the declivity strongly convex, interspaces shining, rather coarsely granulate and setose-punctate uniseriately. The male has the front somewhat wider than the female, plano-convex, densely, coarsely, roughly punctured, with a shallow, transverse, post-epistomial impression and a faint median carina in front and behind, sparsely clothed with long hairs; the declivity more polished, the punctures minute and the granules small and sparse on the first two interspaces.

Type locality: Colorado.
Distribution: British Columbia to Alberta, south into Oregon, through the Rockies to Montana and Colorado.
Hosts: *Abies lasiocarpa*, *A. balsamea*, and probably other *Abies*.
Notes: This species attacks and kills healthy trees. Swaine (33:25) reports it as killing quantities of balsam fir in the high plateau region of British Columbia. In that locality the beetle has the habit of cutting a second egg tunnel, as an extension of the first without the labor of excavating a second entrance tunnel.

*Dryocoetes confusus* emerged in late June (Mathers 1931) and flight continued through July (Stanley, British Columbia). Attack and egg laying continued well into August. Feeding tunnels are excavated from the nuptial chamber by the male and the female continues the egg tunnel but no longer deposits eggs. Winter is passed by the parent adults in these tunnels. In the spring the female continues the tunnel which has been successively egg tunnel, feeding tunnel, and hibernating tunnel. She extends this mine for food and then in the fresh extension she deposits eggs for a second brood. Such extensions are about one inch in length and contain 5 to 14 eggs. In July the parent female leaves the tree, entering a new host where a third set of brood tunnels are excavated. The complete life cycle requires approximately two years.

*Dryocoetes affaber* (Mannerheim) 52:359
Length 2.6 to 3.2, elongate cylindrical, quite shining, covered with short yellow hairs. Pronotum narrowed in front, roughly granulate, tending to be asperate in front. Elytra feebly striate-punctate, intervals irregularly punctate. *D. affaber*, *D. picea* and *D. pubescens* are all very closely related and may prove to be only variations of a single species.
Type locality: Alaska.
Distribution: Western United States and western Canada, as far east as Alberta, also found in Alaska. Occurs in both Eastern and Western Oregon and Washington.

Hosts: All species of *Picea* within its range, also reported from *Pinus* and *Abies*. Bedard (38:194) found it working in Douglas-fir in Idaho. Oregon and Washington specimens are from *Abies lasiocarpa*.

Work: The gallery consists of a central chamber from which the egg galleries, usually three in number, radiate.

*Dryocoetes septentrionis* Mannerheim 43:298

According to Blatchley and Leng (16:613) this is a synonym of *D. autographus*. Swaine (18:131) gives it specific standing and lists *D. semicastaaneus* (Mann.) as a synonym. *D. pseudotsugae* Sw. (15:360) is also placed as a synonym by Wood (in correspondence) who has examined the types of all the species involved.

This species (fig. 113) is similar to *americanus* but differs by being somewhat larger, usually more than 4 mm. long; smaller pronotum with strongly arcuate sides, definitely narrowed in front and behind, especially in front and by the wider elytral interspaces. The male has the front very wide, the declivity somewhat flattened and frequently obscurely granulate.

Type locality: Russian America, probably Alaska.

Distribution: Alaska to Oregon, eastward across Canada to the Northeastern spruce forests.

Hosts: *Picea sitchensis, P. engelmannii, P. canadensis, Pseudotsugae menziesii*, and *Abies* spp.

Habits: Although a common species, it seldom attacks living trees and very often the gallery is entirely in the bark so the species is of little or no economic importance.
Galleries are in the inner bark of Douglas-fir; they are short and irregular, often clustered together so closely that it is impossible to trace out individual galleries. Winter hibernation galleries are in the inner bark and not in the cambium. They are considerably larger than the brood galleries, as many as 20 adults have been found crowded into one hibernating gallery.

**Dryocoetes sechelti** Swaine 15:358

Length 2.1 mm. The head is more deeply embedded in the pronotum than usual, with erect hairs on the front. Eyes are wide, coarsely granulate, and emarginate; the antennal club is longer than the funicle, pedicel as long as the outer four segments; elytra as wide as the pronotum, venter closely and roughly punctured.

Type locality: Sechelt, British Columbia.

Distribution: British Columbia, Idaho, and Oregon. Although no specimens have been seen from Washington it doubtless will be found in that state.

Host: *Abies lasiocarpa*.
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## INDEX

### INDEX TO THE GENERA AND SPECIES OF SCOTYIDAE OF THE NORTHWEST

The genera are arranged alphabetically and the species are in alphabetical order under the genera. Synonyms are in italics. Genera and Species found in the Northwest as well as the principal page reference are in boldface type.

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