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A TAXONOMIC STUDY OF THE SCOLYTIDAE
(COLEOPTERA) OF THE LOGAN CANYON AREA OF UTAH

by

Stephen L. Wood

THESIS

Submitted in Partial Fulfillment of the
Requirements for the Degree of

MASTER OF SCIENCE

in

Entomology

in

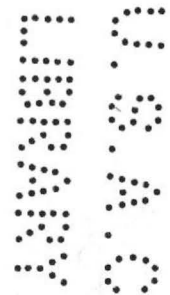
THE GRADUATE SCHOOL

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WESTERN BOND



A TAXONOMIC STUDY OF THE SCOLYTIDAE
(COLEOPTERA) OF THE LOGAN CANYON AREA OF UTAH

INTRODUCTION

In spite of the great economic importance of north American Scolytidae, many taxonomic descriptions remain inadequate for the identification of species, and existing keys have been made obsolete by the recent description of new species. To bring these keys up to date and make them useful to students and practical foresters, detailed studies of the morphological structure of the various species are necessary. The purpose of the present investigation has been to clarify and revise existing keys and to describe briefly the species of Scolytidae occurring in the Logan Canyon area of Utah. The following keys and descriptions will be of value to students, foresters, and taxonomists in identifying the species of Scolytidae occurring in northern Utah. Information secured in this investigation also contributes toward the geographic and host distributional knowledge of the Scolytidae in Utah.

METHODS OF PROCEDURE

Selection of the Collecting Area

Logan Canyon was selected for this investigation because it is one of the largest and most important canyons of northern Utah and is readily accessible for study. The elevation of the canyon varies from about 4700 to well over 9000 feet, giving a wide range of biological life zones and a great variety of Scolytid host plants. Although logging is relatively unimportant, bark beetles remain as an important agent of destruction to

shrubs and trees of the watershed and the numerous recreation areas. Even though more is known of the Scolytidae of Logan Canyon than in other areas of Utah, only a fraction of the number of species has been reported previously.

In the selection of collecting areas within the Canyon, an attempt was made to collect from as many host species as possible at several elevations, and from a wide variety of locations if the host range would permit.

Habits of the Scolytidae

Scolytid beetles usually breed beneath the bark of trees and shrubs, where the entire life cycle is spent except for a brief period spent by the adult beetles in flying from the brood tree to attack a new host. The adult beetle usually enters the host through an entrance tunnel cut obliquely upward through the bark to the wood surface. The entrance tunnel ordinarily is located on a scarred area or at the base of a twig. From the inner end of the entrance tunnel one or more egg tunnels are cut along the cambium, or into the wood, in a manner which generally is characteristic of the species. Many species excavate a small flat room or nuptial chamber at the base of the entrance tunnel, the egg tunnels originating from there. Cup-shaped notches are made along the sides of the egg tunnels by the female beetle. An egg is then deposited in each notch, after which boring dust is packed into the notch, sealing in each egg. The larvae excavate slender mines along the inner bark, away from the egg tunnel, filling the mine with boring dust and excrement as they progress. The larval mines gradually increase in size and vary in direction to form a pattern characteristic of the species. At the ends, the

larval mines are widened and cleared to form a pupal cell, which may lie in the outer bark, in the cambium region, or in the wood. After feeding for several days, the adult beetles emerge through small individual circular holes in the bark.

Ambrosia beetles differ in habits from the bark beetles by cutting their tunnels deep into the wood and rearing their larvae in the branches of the tunnels. Ordinarily, both larvae and adults feed on a fungus which is reared by the beetles in the tunnels.

Collecting

Scolytid beetles are usually found breeding in trees or branches which have recently been killed or those in an unthrifty and weakened condition. The foliage of such trees and branches is generally light yellow or brown. The presence of the beetles in such trees can readily be detected during the summer months by the accumulation of boring dust on the bark. At other times of the year, the small circular entrance tunnels are visible in the bark of infested parts of the host. Removal of the bark will uncover the egg tunnels and larval mines, exposing the beetles and larvae.

During the period of this study, as many as one hundred adult specimens of each species, if available, with several pupae, larvae, and eggs, were collected in each series and preserved in a one-dram vial of 70 percent by volume of ethyl alcohol. The vial was labeled with a collection serial number, the location, the date, and the host plant. It was then taken to the laboratory where a representative series of five to twenty adult specimens was mounted individually on pinned paper points and labeled.

Rearing of Immature Specimens

Occasionally a collection, particularly during the winter months, would yield only larval specimens, necessitating the rearing of adults for the determination of species. If the larvae were infesting twigs or branches two inches or less in diameter, the material was taken to the laboratory where it was cut into convenient lengths and the cut ends dipped in melted paraffin wax to prevent drying. These sections were placed in a two-quart or a one-gallon glass jar. The jar was then covered by a clean white cotton cloth, held in place by a rubber band, and left until the adult beetles emerged. If the bark became too dry, the cloth was kept moist by adding a few drops of water each day.

Branches between two and four inches in diameter were cut into ten- to fifteen-inch lengths, the ends waxed, and then placed in a twenty-five-pound paper bag. The open end of the bag was then gathered and tied around the mouth of a clean pint jar; when the beetles emerged, they were attracted to the light and collected in the jar. When the ends of larger branches were covered with wax, they usually contained sufficient moisture for the completion of larval development.

Limbs and boles of trees larger than four inches in diameter were not cut and taken to the laboratory for rearing. The bark was removed in the field, and the larvae and pupae were placed in a metal pill box two inches in diameter and five-eighths of an inch deep; then a few grams of boring dust or shavings of the inner bark were added. A drop of water was added each day if necessary to prevent drying, extreme care being taken to prevent the growth of mold. This was the most satisfactory method used for rearing third and fourth instar larvae and pupae, but it was not always successful with smaller larvae.

The time necessary for the completion of development was dependent on the temperature, moisture, and the stage of larval development at the time of collection. The rearing containers were kept out of the direct sunlight in a room at 24° to 26° C. The adult beetles ordinarily emerged in from one to twenty days.

Keeping of Records

At the site of each collection, information was recorded which was of value in determining the species of Scolytidae collected. This information was recorded in eight vertical columns of a spiral notebook from left to right as follows: (1) the collection serial number, (2) space for the scientific name of the species collected, (3) the locality, which includes the particular part or branch of the canyon, and also the quarter, section township, and range where the collection was made, (4) the date, (5) the scientific name of the host plant, (6) the elevation at which the collection was made, (7) the portion of the host attacked by the beetles, and (8) the condition of the host plant at the time of the collection (this includes whether or not the host was dead, and if so, how long had it been dead and how was it killed). Data on injury and site condition were kept separately on four-by-six-inch forms indexed under the collection serial number. The map used to determine the location and elevation was the United States Department of the Interior Geological Survey map, Utah-Idaho, Logan Quadrangle, polyconic projection, 1916 edition, 1939 reprint.

In addition to the detached notebook records, the pin of each mounted specimen bears two labels. The upper label, located just below the specimen, contains locality data, the date, and the name of the collector. The second label gives the name of the host and the elevation. On the under side of

the lower label the collection serial number is written.

THE SCOLYTIDAE OF THE LOGAN CANYON AREA

Most of the following keys and descriptions are original; however in some instances the descriptions have been adapted from the descriptions in the revisional works of Dr. M. W. Blackman. This is true of the descriptions of Renocis heterodoxus Casey, Phloeosinus hoferi Blackman, P. neomexicanus Blackman, Pseudohylesinus nebulosus (LeConte), and Myeloborus pinguis Blackman. Adaptations of these descriptions have been included because the literature is scattered and not readily available. Descriptions of the species belonging to the genera Scolytus Geoffroy and Pityophthorus Eichhoff have not been included here because adequate descriptions have been given in the revisional studies of Blackman (1928 and 1934), and a large number of species of each genus occurs in the Logan Canyon area, making examination of these revisional works worth while.

In the discussion of each species the reference to the original description is given; this is followed by a description of each species made directly from identified specimens. The type locality, distribution, and host range are listed as found in the literature; these data are taken from the original descriptions supplemented by Chamberlain (1939), Swaine (1918), and other minor sources.

The literature contains only two short annotated lists of the Scolytidae of the Logan Canyon area. Thatcher (1935) reported sixteen species one of which, Scolytus piceae Swaine, was incorrectly identified according to Mr. Thatcher. The determination of Ips chamberlini Swaine will not be accepted until the specimens have been examined. The second paper by

Knowlton and Nye (1939) listed nine additional species from the insect collection of the Utah State Agricultural College. In addition to these papers the best work available dealing with north American Scolytidae is that by Chamberlin (1939). Many of his keys are inadequate, and all of his descriptions are too brief for proper identification. In this work very few species are reported as occurring in Utah.

The species of Scolytidae presented in this study were determined by the author; the more difficult and questionable species were checked at the United States National Museum, Washington, D. C., by Dr. W. H. Anderson. The species determined by Dr. Anderson have been so designated.

The Systematic Position of the Family Scolytidae

- A. Gular sutures separate; maxilla divided, palp usually four segmented; prosternal sutures distinct; larvae usually with legs
 other Coleoptera
- AA. Gular sutures confluent on median line or lacking; maxilla undivided, short and rigid, of not more than three segments; prosternal sutures lacking; larvae legless. (Rhynchophora)
- B. Beak well developed; submentum strongly produced behind; tibiae without teeth on outer apical margin, and usually without a prominent apical process; antennae variable
 other Rhynchophora
- BB. Beak short and indistinct; submentum not strongly produced behind; tibiae with teeth on outer apical margin, or with a prominent apical process; antennae rather short, (geniculate and clavate (Scolytoidea)
- C. First segment of anterior tarsi longer than other segments united; head prominent, as broad as thorax

- Platypodidae
- CC. First anterior tarsal segment much shorter than others united; head much narrower than thorax . . . Scolytidae

Family Scolytidae Geoffroy

The north American species of Scolytidae are divided into five sub-families, three of which are known to occur in Logan Canyon; a key to the three subfamilies follows.

Key to the Subfamilies of Scolytidae

- A. Sides of fore tibiae smooth and subparallel, outer apical angle produced into a prominent process. Scolytinae
- AA. Outer margin of fore tibiae with a series of small teeth and usually with a variable prominent apical process.
- B. Head visible from above; pronotum not noticeably granulate or asperate in front. Hylesininae
- BB. Head concealed from above; pronotum distinctly granulate or asperate anteriorly Ipinae

Key to the Genera of Scolytinae

- A. Venter of abdomen horizontal; eyes hemispherical; antennal club small and connate Rhyncolus Germar (Xylocomesus Thatcher)
 - AA. Venter of abdomen ascending abruptly; eyes large, oval, and weakly emarginate; antennal club large and oval Scolytus Geoffroy
- Rhyncolus Germar (Xylocomesus Thatcher)

Thatcher (1940) described the genus Xylocomesus from a species collected at Baker, Nevada, and a second species collected in Logan Canyon. Buchanan (1942) placed the genus as a synonym of Rhyncolus Germar in the family Curculionidae. Specimens of both species have been

examined in this study and found to differ from the Scolytidae in the characters of the submentum. The general appearance resembles some Curculionidae, but the beak is broader than long and the fore tibiae resemble those of typical Scolytus.

Scolytus Geoffroy

Body stout, cylindrical. Eye elongate, broadly, shallowly emarginate on the inner margin. Antennal scape short; funicle seven segmented; club flattened, irregularly ovate, with three sutures, the first distinct. Anterior tibiae stout, sides parallel, with outer distal angle produced into a prominent curved process; tarsi nearly as long as tibiae, third joint bilobed. Venter of abdomen ascending abruptly behind.

Key to the Species of Scolytus

- A. Abdominal segments unarmed in both sexes, second not concave.
 - B. Entire surface of elytra covered with hair; second abdominal segment gradually ascending, without a distinct transversely elevated line. S. rugulosus Ratzeburg
 - BB. Elytra nearly glabrous; second abdominal segment ascending abruptly, with a distinct transversely elevated line S. monticolae (Swaine)
- AA. Second abdominal segment carinate, tuberculate, or concave.
 - B. Second abdominal segment concave in both sexes and strongly carinate in males at least.
 - C. Second abdominal segment strongly carinate only in male, opaque, finely rather closely shallowly punctured S. praeceps LeConte

- CC. Second abdominal segment strongly carinate in both sexes, subopaque, punctures very fine and sparse, sometimes almost obsolete S. opacus Blackman
- BB. Second abdominal segment not concave, bearing a long slender spine.
- C. Base of abdominal spine reaching posterior margin of second segment; elytral punctures fine and shallow; in Douglas Fir S. unispinosus Le Conte X
- CC. Abdominal spine arising from center of second segment, not reaching posterior margin; elytral punctures more strongly impressed; in Spruce S. piceae (Swaine) X

Scolytus rugulosus Ratzeburg

Ratzeburg, J. T. C. Die Forstinsekten 1:187, 1837. Redescribed by Blackman (1934) p. 10.

Type locality - Europe

Distribution - Europe and the entire United States.

Hosts - The species of Prunus, Pyrus, and Crataegus.

A very destructive species to orchard fruit trees. Knowlton and Nye (1939) report it from Prunus virginiana melanocarpa in Green Canyon.

Scolytus monticolae (Swaine)

Swaine, J. M. (As Eccoptogaster) Dom. Can. Dept. Agr. Ent. Br. Bull. 14 (1):32, 1917. Redescribed by Blackman (1934) p. 15.

Type locality - British Columbia.

Distribution - British Columbia, Washington, Oregon, Idaho, Montana, Wyoming, and Utah.

Hosts - Pinus monticola, Pseudotsuga taxifolia, Tsuga mertensiana, and Abies species.

This is a common species in shaded out branches 1-3 inches in diameter of Pseudotsuga taxifolia. Collected at Dry Canyon Dec. 24, 1945, 5000 ft.; and again April 28, 1946, 5500 ft.; and at Logan Cave Dec. 31, 1945, 6200 ft. Thatcher (1935) also lists this species from Abies lasiocarpa. The specimens reported by Knowlton and Nye (1939) as S. wickhami Blackman have been examined and are S. monticolae.

Scolytus praeceps LeConte

LeConte, J. L. Proc. Amer. Phil. Soc. 15:371, 1876. Redescribed by Blackman (1934) p. 20.

Type locality - California.

Distribution - California, Arizona, Utah, Idaho, and Oregon.

Hosts - The species of Abies.

A rare species in Logan Canyon which was collected from bark of the bole of Abies lasiocarpa at Franklin Basin July 24, 1946, 8000 ft.

Scolytus opacus Blackman

Blackman, M. W. U.S.D.A. Tech. Bull. 431:20, 1934.

Type Locality - Ouray, Colorado.

Distribution - Colorado, Montana, and Utah.

Hosts - Abies lasiocarpa.

A rare species taken from the bark of the bole of Abies lasiocarpa. Collected at Dry Canyon June 16, at 7000 ft., and again June 29, 1946, 8000 ft. Thatcher (1935) reported this species from Pseudotsuga taxifolia (micronata used by Thatcher).

Scolytus unispinosus LeConte

LeConte, J. L. Proc. Amer. Phil. Soc. 15:372, 1876. Redescribed by Blackman (1934) p. 26.

Type locality - Oregon.

Distribution - Throughout Pacific Coast and Rocky Mountain region.

Hosts - Pseudotsuga taxifolia, P. macronata.

Rather abundant in the bark of 1-3 inch branches of Pseudotsuga taxifolia, frequently doing damage by killing the older less vigorous branches. Collected near the mouth of Logan Canyon Dec. 31, 1945, 5000 ft.: Dry Canyon May 1, and again June 16, 1946, 6000 ft. Thatcher (1935) also reported this species from Logan Canyon.

Scolytus piceae (Swaine)

Swaine, J. N. (As Eccoptogaster) Can. Ent. 42:33, 1910. Re-described by Blackman (1934) p. 26.

Type locality - Hudson, Quebec.

Distribution - Through southern Canada, Maine to New York, west to Montana, Wyoming, and Colorado.

Hosts - Picea canadensis, P. rubens, P. engelmanni, Larix laricina, and Abies balsamea.

An uncommon species in Logan Canyon which breeds in the limbs and branches of Picea engelmanni. It was collected at Franklin Basin July 24, 1936, 8000 ft.; and at the Summit of West Hodge Creek June 13, 1947, 8500 ft. Thatcher (1935) originally reported this species from Abies lasiocarpa, but later withdrew the identification on reprints of his paper.

Key to the Genera of Hylesiniinae

- A. Antennal funicle of two segments: club sutured only at tip; length less than 1.5 mm Crypturgus Erichson
- AA. Antennal funicle of more than two segments; club not sutured only at the tip; larger than 1.5 mm. long.
- B. Antennal funicle of five segments: club strongly compressed.

C. Third tarsal segment cylindrical, not widened. body densely covered with small conspicuous scales.

D. Eyes very feebly sinuate and more than three times as long as wide; fore tibiae dilated distally and margined with a row of six to nine short stout teeth Renocis Casey

DD. Eyes deeply emarginate and about twice as long as wide; fore tibiae not noticeably dilated distally, usually with about four marginal teeth
. Carphoborus Eichhoff

CC. Third tarsal segment dilated and emarginate; scales if present are sparse and inconspicuous.

D. Antennal club loosely segmented, the segments produced on one side, sublamellate; posterior tibiae without distinct teeth on outer margin
. Phloeotribus Latreille

DD. Antennal club conate, the segments equal sided; posterior tibiae with several distinct teeth.

E. Epistomal process well developed; eyes entire; fore coxae very narrowly separated; third fore tarsal segment distinctly bilobed
. Dendroctonus Erichson

EE. Epistomal process normal; eyes deeply emarginate; antennal club not thickened basally; fore coxae moderately separated; third fore tarsal segment emarginate, not belobed Phloeosinus Chapuis

BB. Antennal funicle of seven segments; club not distinctly compressed.

C. Fore coxae widely separated Scierus LeConte

CC. Fore coxae narrowly separated.

D. Elytral bases strongly rounded and armed with large lateral pointed serrations; metasternum slightly inflated, venter of abdomen moderately elevated; first, second, and third abdominal segments subequal in length

. Pseudohylesinus Swaine

DD. Elytral bases nearly straight, not strongly serrate; metasternum normal, venter of abdomen horizontal; first and fifth abdominal segments longer than the others

. Hylurgops LeConte

Crypturgus Erichson

Body stout and cylindrical, from 0.9 to 1.5 mm. long. Antennal funicle of two segments; club segmented only at tip. Pronotum and elytra unarmed; tibiae with teeth on the outer edge.

Crypturgus borealis Swaine

Swaine, J. M. Dom. Can. Dept. Agr, Ent. Br. Bull. 14 (1):7, 1917.

Length 1.2 mm., 2.73 times as long as wide; color dark brown to black, clothed with rather abundant short erect yellow hair.

Female - Head coarsely reticulate; front convex with postepistomal region triangularly flattened, finely, sparsely setose-punctate, with a small circular pit in center. Eye oval, twice as long as wide, slightly wider above, coarsely granulate, deeply, narrowly emarginate on inner margin. Antennal funicle of two segments, club subquadrate and segmented only at tip.

Pronotum 1.17 times as long as wide, coarsely reticulate, broadly rounded in front, widest on posterior half; punctures fine, shallow, and moderately close; pubescence of short distinct yellow hair.

Elytra 1.82 times as long as wide, sides subparallel on basal two-thirds, strongly narrowed on caudal third; striae wide, weakly impressed except first which is moderately impressed; interspaces narrow, coarsely granulate, and bearing a row of fine closely placed erect yellow hair; striae similar to those of interspaces, but shorter except on declivity; apical half of declivity covered by a subcircular brown slightly swollen spongy area.

Male - Postepistomal area of front plano-concave; declivity normally pubescent, without spongy area.

Type locality - Winnipeg, Manitoba, Canada.

Distribution - Manitoba to the Pacific, south in the Rocky Mountain area to Colorado.

Hosts - Larix laricina, Picea canadensis, P. sitchensis, and Abies lasiocarpa.

This is an abundant species in Logan Canyon in the bark of the bole of Abies lasiocarpa. The species of this genus differ from most other bark beetles by entering the bark through the entrance tunnel of some other Scolytid, then constructing their galleries from the larger tunnel. Collected at Amazon Mine June 13, 1946, 7200 ft.; Dry Canyon June 16, 7000 ft., and again June 29, 1946, 8000 ft.; Franklin Basin July 5, 1946, 7300 ft.; the Summit of Logan Canyon Aug. 9, 1946, 8000 ft.; and West Hodge Creek May 17, 1947, 8000 ft.

Thatcher (1935) and Knowlton and Nye (1939) also report this as an abundant species in Abies lasiocarpa.

Renocis Casey

Body stout, usually less than twice as long as wide, densely clothed

with small recumbent scales. Frons concave in male at least. Antennal funicle five segmented; club compressed, often elongate. Pronotum much wider than long, strongly narrowed in front. Elytra with bases strongly elevated and with coarse crenulations; scutellum lacking. First and second abdominal sternites subequal, each as long as third and fourth united.

Renocis heterodoxus Casey

Casey, T. L. Calif. Acad. Sci. Bull. 6:257, 1886. The following description was adapted from Blackman (1940) p. 387.

Length 1.5 to 2.5 mm., twice as long as wide; piceous-black, densely clothed with small brown and cinerous scales, with erect brown, spatulate setae.

Male - Frons with epistomal margin bearing a ventrally directed fringe of coarse hair, a sharp tooth in middle; broadly impressed to form a shallow, subtriangular concavity between eyes; sides slightly elevated; median concavity finely, sparsely punctured, more closely, coarsely punctate-granulate at sides and above; clothed with coarse moderately long light-brown hair, becoming sparse below. Eye 3.5 times as long as wide, finely granulate, inner angle broadly sinuate. Antennal funicle longer than scape; club 2.26 times as long as wide, with three nearly straight sutures marked by setae, not septate.

Pronotum 1.52 times as wide as long, widest near base; sides strongly arcuate behind, strongly constricted anteriorly, a transverse impression just behind the broadly rounded sinuate anterior margin; disc finely densely punctate-granulate, with two small groups of small slender asperities at each side; entire surface densely clothed with small recumbent scales.

Elytra 1.29 times as long as wide, slightly wider than pronotum;

sides straight and subparallel on basal two-thirds, broadly rounded behind; basal margins strongly elevated medially, five coarse, high serrations on each; first and second striae moderately impressed, others weakly impressed, punctures small and close; interspaces rugose, finely punctured, often accompanied by small granules, surface covered with numerous small recumbent scales, with a single row of erect, spatulate setae medially. Declivity moderately sloping, first and second interspaces broad and flat, slightly depressed; third interspace bearing a few feeble granules.

Female - Frontal concavity shallower, frontal hair shorter, and antennal club broader than in male.

Type locality - Reno, Nevada

Distribution - Utah, Nevada, California, and Oregon.

Hosts - Amelanchier florida, Cercocarpus betuloides, C. alnifolius, C. ledifolius, and Prunus virginiana melanocarpa.

A very common species in the bark of limbs and branches 0.5 to 5 inches in diameter. Collected at Dry Canyon Dec. 23, 1945, 5000 ft. in Cercocarpus montanus; Dry Canyon March 4, 1946, 6000 ft., and Card Canyon July 17, 1946, 7600 ft. in C. ledifolius; Temple Fork July 21, 1946, 7600 ft. in Amelanchier florida; and Dry Canyon Dec. 30, 1945, 4800 ft. in Prunus virginiana melanocarpa.

Thatcher (1935) and Knowlton and Nye (1939) also reported this species from Logan Canyon. Blackman (1940) refers to the collections of Thatcher.

Carphoborus Eichhoff

Body oval, cylindrical, rather densely clothed with small conspicuous scales. Antennal funicle five segmented; club flattened, oval with

three distinct sutures. Pronotum wider than long, finely, densely punctate; scutellum absent. Elytral bases moderately elevated and serrate; striae coarsely punctured; interspaces roughened, usually alternately elevated and serrate on the declivity. Fore tibiae rather feebly dilated distally with two acute teeth on the outer margin near the apex, a long terminal process on the inner angle; third tarsal segment cylindrical, not widened.

Three new undescribed species belonging to the genus Carphoborus have been collected during this study. Because only a few specimens have been collected, the descriptions will not be included here, but will be published later when more material is available.

Phloeotribus Latreille

Antennal club semi-lamellate, composed of three loosely jointed segments; funicle five segmented; middle and hind tibiae rounded on outer margin, at least the hind tibiae without distinct teeth.

Phloeotribus puberulus LeConte

LeConte, J. L. Bull. Geog. Survey 5:519, 1879.

Length 2 to 2.5 mm., 2.48 times as long as wide; color black, clothed with moderately long, coarse erect gray hair.

Male - Frons broadly impressed to form a moderately deep triangular concavity between the eyes; sides slightly elevated; median concavity shining, nearly smooth, becoming finely granulate-punctate at sides and above; frons bearing a small pointed tubercle at center of the elevated lateral margins, a weakly elevated, arched, transverse carina between the tubercles; sparsely clothed with moderately long, fine, yellow pubescence. Eye ovate, wider above, 2.43 times as long as wide, margin entire. Antennal club composed of three loose, semi-lamellate segments, lamellate exten-

sions about as wide as their basal width.

Pronotum 1.25 times as wide as long, widest on posterior half; sides arcuate, strongly constricted anteriorly with a transverse impression behind the broadly rounded anterior margin; discal punctures coarse, deep, close, not as deep laterally; clothed with moderately long, erect, coarse gray hair.

Elytra 1.62 times as long as wide, wider than pronotum; sides straight and subparallel on basal half, tapering on posterior half, narrowly rounded behind; basal margins bearing a row of transversely flattened, moderately high serrations which become narrower and more pointed laterally; striae weakly impressed, punctures large and separated by less than their own diameters; interspaces about as wide as striae, finely, uniseri-ally granulate, each granule bearing a moderately long, gray setae; pubescence of striae fine, and short; ninth interspace slightly elevated behind and finely granulate-serrate. Declivity rather gradually sloping, striae moderately impressed; interspaces and the apical margin finely serrate.

Female - Frons convex; frontal tubercles absent.

Type locality - Vete Pass, Colorado.

Distribution - Colorado and Idaho.

Hosts - Pseudotsuga taxifolia.

Common in the bark of shaded out branches one to three inches in diameter. Collected at Dry Canyon Dec. 24, 1945, 5000 ft., May 1, and again June 16, 1946, 6000 ft.; Card Canyon July 17, 1946, 7300 ft. from Pseudotsuga taxifolia; Logan Cave Dec. 31, 1945, 6200 ft. and Dry Canyon June 19, 1946, 6500 ft. from Abies lasiocarpa; Dry Canyon May 30, 1947, 8500 ft. from Picea engelmanni.

Dendroctonus Erichson

Body large, stout, cylindrical; head broad and prominent. Beak prominent, epistomal process well developed. Eyes transverse, oval, entire. Antennal funicle five segmented; club broad, thickened basally, flattened distally. Pronotum wider than long, about as wide as elytra, punctured throughout, devoid of asperities. Elytra crenulate at base, striae impressed; declivity abrupt. Anterior coxae approximate; third tarsal segment dilated and bilobed.

Key to the Species of Dendroctonus

- A. Epistomal process not reaching margin; frons moderately convex, moderately impressed above epistomal process; second declivital interspace as wide as first and third, the second striae sinuate.
- B. Median line of vertex of head broadly impressed; sides of pronotum subparallel on posterior two-thirds, punctures small, shallow, regular; strial punctures not distinct on declivity; color dark brown to black D. monticolae Hopkins
- BB. Median line of vertex not impressed; pronotum distinctly narrowed from base, punctures moderately impressed, a few large punctures intermixed with numerous small impressed ones; strial punctures reduced, but distinct on declivity; color reddish-brown D. valens LeConte
- AA. Epistomal process reaching margin; frons convex and elevated above epistomal process; median line of vertex impressed; second interspace narrower and more depressed than first and third; second striae straight D. pseudotsugae Hopkins

Dendroctonus monticolae Hopkins

Hopkins, A. D. U.S.D.A. Bur. Ent. Bull. 56:11, 1905.

Length 3.7 to 6.7 mm., 2.1 times as long as wide; color dark brown to black; sparsely clothed with yellow hair.

Frons convex, feebly impressed above; epistomal process broad, concave, with sides oblique; coarsely, closely punctate-granulate, finely punctured above. Eye oval, 2.4 times as long as wide. Antennal club about as wide as long, compressed, thickened basally.

Pronotum 1.4 times as wide as long, as wide as elytra, widest posteriorly, posterior two-thirds with the sides subparallel, distinctly constricted one-fourth the distance from anterior margin; anterior margin broadly emarginate; punctures small, close, regularly placed.

Elytra 1.45 times as long as wide, striae distinctly impressed, more feebly on sides; punctures small, close; interspaces twice as wide as striae, slightly convex, granulate. Declivity abrupt; striae strongly, narrowly impressed; second and third striae strongly sinuate; pubescence short and sparse, with a few long hairs intermixed.

Sexual differences not pronounced.

Type locality - Kootena, Idaho.

Distribution - British Columbia south through the Rocky Mountain and Pacific Coast states.

Hosts - The species of Pinus, Tsuga martensiana, Picea engelmanni.

This species is probably the most serious insect enemy of pines in Logan Canyon. It aggressively attacks and kills healthy trees at the higher elevations. Collected at Beaver Creek July 26, 1946, 8500 ft., and again June 14, 1947, 8000 ft. from the bole of Pinus Flexilus; the Summit of Logan Canyon Aug. 9, 1946, 8000 ft. from the bole of P. contorta.

Thatcher (1935) and Knowlton and Nye (1939) also reported this species from Logan Canyon.

Dendroctonus valens LeConte

LeConte, J. L. Pac. R. R. Explor. Ins. V, 12(2):59, 1860.

Length 5 to 9.5 mm., about 2.5 times as long as wide; color reddish, sparsely clothed with long yellow hair.

Frons convex; epistomal process broad, concave, sides oblique; head granulate-punctate; median line of vertex black. Eye oval, 2.8 times as long as wide. Antennal club wider than long, compressed, thickened basally.

Pronotum 1.32 times as wide as long, widest posteriorly, distinctly constricted one-fourth the distance from anterior margin; anterior margin broadly emarginate; discal punctures of medium size, close, strongly impressed.

Elytra 1.5 times as long as wide, very slightly wider than pronotum; striae distinctly impressed, punctures close, distinct; interspaces granulate and wider than striae. Declivity abrupt, strial punctures reduced in size; interspaces each with a row of small granules; pubescence sparse, mostly short with a few long hairs intermixed.

Sexual differences not pronounced..

Type locality - California.

Distribution - North and Central America.

Hosts - The species of Pinus, Picea canadensis, P. excelsa, P. rubens, Abies concolor, Larix laricina, Pseudotsuga taxifolia.

A common species in Logan Canyon which attacks the base of the bole and the roots of dying pines. Collected at Beaver Creek Sept. 25, 1946,

8700 ft. from Pinus flexilis; and Amazon Mine June 14, 1947, 7200 ft. from P. contorta.

Dendroctonus pseudotsugae Hopkins

Hopkins, A. D. U.S.D.A. Bur. Ent. Tech. Bull. 17(1):126, 1909.

Length 3.5 to 7mm., 2.3 times as long as wide; color dark brown to black, elytra reddish-brown.

Frons with epistomal process slightly projecting, reaching epistomal margin; strongly, deeply impressed just above epistomal margin, except middle third which is elevated; convex, broadly impressed on median line above; coarsely granulate-punctate, finely punctured above; pubescence of very sparse, short hair. Eye ovate, twice as long as wide, margin entire. Antennal club as long as wide, flattened, thickened basally.

Pronotum 1.6 times as wide as long, widest on posterior half, constricted anteriorly; anterior margin rather deeply emarginate; finely, closely punctured, with a few large punctures intermixed; median line broad, distinct; surface shining, pubescence fine, short, longer laterally.

Elytra 1.65 times as long as wide, slightly wider than pronotum; sides straight and subparallel on basal two-thirds, broadly rounded behind; first striae moderately impressed, punctures close, distinct; interspaces wider than striae, moderately granulate-punctate; surface shining, very sparsely clothed with long yellow hair. Declivity abrupt; striae impressed, punctures reduced in size; interspaces convex, with a few large granules in rows; sparsely clothed with long yellow hair.

Sexual differences not pronounced.

Type locality - Grants Pass, Oregon.

Distribution - Rocky Mountain and Pacific Coast states, and western

Canada.

Hosts - Pseudotsuga taxifolia, P. macrocarpa, Larix occidentalis, and Tsuga heterophylla.

Common in the bark of the bole of Pseudotsuga taxifolia. Collected at Little Bear Hollow May 17, 1947, 8000 ft.

Thatcher (1935) and Knowlton and Nye (1939) report this as a common species in Logan Canyon.

Phloeosinus Chapuis

Body stout, oval, strongly convex; pubescence of hair and scales. Eyes elongate and strongly emarginate. Antennal funicle five segmented; club elongate, compressed with three oblique sutures. Pronotum wider than long. Anterior margins of elytra arcuate, serrate; striae distinctly impressed, narrower than interspaces; declivity with alternate interspaces more strongly asperate or serrate. Fore coxae moderately widely separated.

Key to the Species of Phloeosinus

- A. Second declivital interspace distinctly narrower than first or third; declivital serrations small, sharp; carina in male reduced to a tooth on epistoma; less than 2.5 mm. P. hoferi Blackman
- AA. Second declivital interspace as wide as first and third and entirely devoid of serrations or tubercles; declivital serrations large and recurved; longer than 3 mm. P. neomexicanus Blackman

Phloeosinus hoferi Blackman

Blackman, M. W. Proc. U. S. Natl. Mus. 92(3154):412, 1942.

The following description was adapted from the original.

Length 1.75 to 2.35 mm., 2.13 times as long as wide; color black with elytra piceous to reddish-brown.

Male - Frons wide, epistomal lobe short; surface piceous black, moderately shining, finely, closely granulate-punctate at sides, punctured and subgranulate above; deeply, broadly concave from upper level of eye to epistomal margin, finely punctured except at center, median carina lacking except for a small carinal tooth on epistomal margin; pubescence fine and short. Eyes three times as long as wide, half divided by a wide U-shaped emargination. Antennal club 1.8 times as long as wide, first two sutures feebly oblique, third suture more strongly oblique.

Pronotum 1.2 times as wide as long, widest on posterior third; sides strongly arcuate on posterior two-thirds, constricted just behind anterior margin; anterior margin broadly rounded; discal punctures deep, close, moderately large; median line feebly elevated on posterior fourth.

Elytra 1.33 times as long as wide, wider than pronotum; sides straight, subparallel on anterior two-thirds, broadly rounded behind; surface shining; striae deep, moderately wide, punctures moderately large, close; interspaces convex, twice as wide as striae, finely granulate-punctate anteriorly, becoming uniseriately asperate on alternate interspaces behind. Declivity with first and third interspaces convex, with dark, coarse, recurved serrations, punctures fine, close; second interspace flat, narrower than third, narrower toward apex, shining, devoid of serrations; fifth, seventh, and ninth interspaces with few serrations.

Female - Frons convex with a definite, elevated carina on lower half; serrations of declivity finer; more abundant scale-like pubescence.

Type locality - Ute Pass, Colorado.

Distribution - Utah, Colorado, Arizona, and New Mexico.

Hosts - Juniperus scopulorum, J. utahensis, and J. pachyphloea.

A rather common species collected under the bark of small branches and twigs of Juniperus utahensis. Collected at Dry Canyon March 17, 1946, 5000 ft.; and at Card Canyon July 17, 1946, 6500 ft. and again at 7500 ft.

Phloeosinus neomexicanus Blackman

Blackman, M. W. Proc. U. S. Natl. Mus. 92(3154):460, 1942.

The following description was adapted from the original.

Length 3.0 to 3.75 mm., twice as long as wide; color black with reddish-brown elytra.

Male.- Frons wide; epistomal lobe nearly lacking; surface feebly shining, moderately coarsely granulate-punctate; shallowly, broadly sub-concave between eyes, with elevated median carina on lower half; pubescence fine, short. Eye nearly three times as long as wide, more than half divided by a narrow emargination.

Pronotum 1.17 times as wide as long, widest posteriorly; sides arcuate converging anteriorly, constricted just behind anterior margin; anterior margin broadly rounded; surface shining; punctures deep, close, moderately large, smaller anteriorly, subgranulate at sides; median line slightly elevated, impunctate behind; lateral calli moderately large; pubescence moderately long, coarse, and conspicuous.

Elytra 1.3 times as long as wide, wider than pronotum, widest in front of middle; sides subparallel, feebly arcuate anteriorly, broadly rounded behind; striae narrow, strongly impressed; punctures small moderately spaced; interspaces several times wider than striae, weakly convex, densely granulate-punctate, with granules tending toward uniseriate arrangement on anterior three-fourths of disc. Declivity with first and third interspaces elevated; serrations large, black, some obsolete; second

interspaces as wide as others, flat, devoid of serrations, finely roughly punctured; a few smaller serrations on the more lateral interspaces; all declivital interspaces with numerous short, stout, yellow hair.

Female - Frons wider, convex; serrations of declivity smaller.

Type locality - Vermejo, New Mexico.

Distribution - Utah, Colorado, Arizona, and New Mexico.

Hosts - Juniperus scopulorum, J. monosperma, J. utahensis, and J. pachyphloea.

The specimens in the Utah State Agricultural College insect collection labeled, "Logan, Ut., Aug. 28, 1929, H. J. Pack Coll., on Cedar," reported by Thatcher (1935) as P. juniperi Swaine, and by Knowlton and Nye (1939) as P. utahensis Swaine, are P. neomexicanus. P. neomexicanus differs from both of these species by having the second declivital interspace entirely devoid of all granules and serrations in both sexes. The pubescence is also longer and more conspicuous than in the more closely related P. juniperi.

Seierus LeConte

Body cylindrical, moderately stout, subopaque, and strongly sculptured; sparsely clothed with short, depressed yellow hair. Antennal funicle seven segmented; club ovate-pointed, the first segment subequal to others united. Eyes ovate and entire. Pronotum wider than long. Elytral striae deeply impressed. Fore coxae widely separated.

Scierus annectens LeConte

LeConte, J. L. Proc. Amer. Phil. Soc. 15:390, 1876.

Length 3.6 mm., 2.3 times as long as wide; color brick-red to picous, opaque, thinly clothed with short depressed yellow hair.

Frons convex above, coarsely shallowly punctate, with a minute yellow hair arising from each puncture; transverse impression between eyes wide and deep; moderately elevated between the impression and epistoma. Eyes ovate, about 2.4 times as long as wide, margin entire. Antennal club ovate-pointed, first segment subequal in length to others united.

Pronotum 1.2 times wider than long, widest just behind middle, strongly rounded on posterior three-fifths; sides strongly arcuate, moderately constricted and transversely impressed just behind the broadly rounded anterior margin; punctures coarse, shallow, densely placed, each bearing a small yellow hair; surface subopaque and feebly granulate; median line feebly elevated and impunctate.

Elytra about 1.65 times as long as wide, wider than pronotum, subparallel on basal three-fourths, broadly rounded behind; striae strongly impressed, punctures moderately small, deep, and very close; interspaces about twice as wide as striae, plano-convex, finely confusedly granulate-punctate. Declivity abrupt; second interspace narrowed and obsolete before apex, third and ninth interspaces moderately elevated and fused before apex, the elevation continuing and fusing with interspace one at the apex. Ventral surfaces shining, episterna scaly.

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

Distribution - Western Canada, Washington, California, Arizona, and Utah.

Hosts - Picea rubens, P. canadensis, P. engelmanni, and Pinus contorta.

This is an extremely rare species throughout its range. A single specimen was collected from the bark at the base of the bole of a large

Dendroctonus killed Pinus contorta at the Summit of Logan Canyon Aug. 9, 1946, 8000 ft.

Pseudohylesinus Swaine

Body cylindrical, suboval; elytral bases strongly arcuate, slightly elevated, regularly serulate; elytra densely scaly; declivity unarmed. Fore coxae narrowly separated; mesosternum moderately inflated; venter of abdomen moderately oblique; first, second, and third abdominal segments subequal in length.

Pseudohylesinus nebulosus (LeConte)

LeConte, J. L. (As Hylesinus) Proc. Acad. N. S. Phila. 5:285, 1859.

The following description was adapted from Blackman (1942a) p. 7.

Length 2.4 to 3.14 mm., 2.46 times as long as wide; color reddish brown to piceous, variably marked with hair and numerous brown and cinerous scales.

Female - Frons piceous, very broad between eyes, convex above; epistomal margin thickened, median lobe wide, broadly and deeply impressed, moderately emarginate in middle; median carina short; surface moderately shining, punctures small and close, finer and deeper below on epistoma. Eye ovate, less than three times longer than wide. Antennal club slightly flattened, first segment slightly longer than the others.

Pronotum 1.16 times as wide as long, widest behind; sides nearly straight, constricted just behind anterior margin and transversely impressed in anterior third; punctures fine, dense, shallow, interspaces finely granulate becoming finely asperate at sides; surface nearly concealed by short erect hairs and small recumbant scales.

Elytra 1.71 times as long as wide, wider than pronotum, widest at base; each base strongly arcuate, armed with serrations which are higher and sharper at sides; sides nearly straight, strongly narrowed and narrowly rounded on posterior half; posterior lateral curvature sharply serrate; striae narrow, impressed, punctures small and close; interspaces finely, densely punctate, with a few large setose granules and punctures on middle of each, setae fine, short, semierect; densely covered by small recumbant scales. Declivity gradually arched; first and third interspaces more strongly convex, granules slightly larger; second interspace slightly narrowed, flat, not granulate; ninth interspace costate with sharp serrations.

Type locality - Table Mountain, California.

Distribution - New Mexico, north to British Columbia, and west to the Pacific Coast.

Hosts - Pseudotsuga taxifolia, Abies concolor, and A. grandis.

An uncommon species in Logan Canyon which breeds in the bark of the bole and large limbs of dead or dying Pseudotsuga taxifolia. Collected at Dry Canyon July 19, 1946, 5500 ft.; Beaver Creek July 26, 1946, 8500 ft.; and the Summit of Logan Canyon Aug. 9, 1946, 8000 ft.

Hylurgops LeConte

Body cylindrical, rather stout; sculpture moderate to very strong. Antennal grooves very deep; funicle seven segmented; club small, oval, the first segment subequal to others united. Pronotum strongly narrowed in front, moderately fine, densely punctured; elytral bases weakly arcuate, feebly elevated and weakly serrate; scutellum not depressed. Fore coxae narrowly separated; mesosternum protuberant; third fore tarsal segment dilated and bilobed. Pubescence variable, small inconspicuous scales usually present.

Key to the Species of Hylurgops

- A. Elytra subinflated behind; pronotum deeply sinuate at sides anteriorly; third fore tarsal segment widened and bilobed
 H. rugipennis (Mannerheim)
- AA. Elytra not inflated behind; pronotum very slightly sinuate at sides anteriorly; third fore tarsal segment moderately widened and emarginate.
 - B. Medium and small pronotal punctures intermixed in equal numbers; disc and declivity deeply striate. H. porosus (LeConte)
 - BB. Pronotal punctures very large, a few small punctures intermixed; elytra rather feebly striate H. lecontei Swaine

Hylurgops rugipennis (Mannerheim)

Mannerheim, G. C. G. von Bull. Soc. Imp. Nat. Moscou 16:297, 1843.

Length 4.4 to 5.3 mm., about 2.5 times as long as wide; color reddish-brown to piceous; pubescence of fine short inconspicuous yellow hair, longer and erect on posterior parts of elytra; densely clothed with minute scales on posterior half of elytra.

Frons convex above with a broad moderately deep, transverse impression at lower level of eyes; epistomal carina strongly elevated and acute, extending from epistomal margin to lower margin of frontal impression; coarsely densely, rather shallowly punctate; pubescence fine, short and inconspicuous except near epistoma. Eye ovate, wider above, feebly sinuate on inner margin. Antennal club oval, first segment shining, subequal to others united.

Pronotum about 1.1 times as wide as long, widest two-thirds of the distance from the broadly rounded anterior margin; sides arcuate, strongly narrowed anteriorly; moderately constricted one-fourth of the distance

from the anterior margin; punctures dense, moderately deep, large and small intermixed, largest three times the diameter of the smallest.

Elytra 1.7 times as long as wide, slightly wider than the pronotum; sides nearly subparallel on anterior two-thirds, very feebly inflated posteriorly, broadly rounded behind; striae strongly impressed, punctures of medium size, moderately close, rather indistinct; interspaces plano-convex, wider than striae, densely and finely punctured, feebly asperate; asperities enlarged posteriorly to large granules, granules moderately widely separated and in rows along center of each interspace; a moderately long, erect setae arising from the base of each granule. Declivity rather steep, interspacial granules continuing to near apex; densely clothed with minute scales.

Female apparently with frontal impression weaker and with fewer elytral scales than male.

Type locality - Alaska.

Distribution - Alaska to California, east through the Cascade-Seirra Nevada range.

Hosts - Pseudotsuga taxifolia, Abies sp., Pinus sp., and Picea sp.

Apparently a common species in Logan Canyon which was collected from the bark of the roots of a large, partly dead Pinus flexilis at Beaver Creek Sept. 25, 1946, 8700 ft., and from P. contorta at Amazon Mine June 14, 1947, 7200 ft.

Hylurgops porosus (LeConte)

LeConte, J. L. (As Hylastes) Amer. Ent. Soc. Trans. 2:175, 1868.

Length 5 mm., 2.8 times as long as wide; color black, pubescence of sparse hair, scaly on declivity.

Frons deeply, transversely impressed between eyes; distinct epistomal carina extending from margin of frontal impression to the epistomal margin; coarsely, closely punctured; pubescence of fine short hair.

Pronotum about 1.1 times as wide as long, widest posteriorly, weakly arcuately narrowed anteriorly; punctures dense, rather deep, medium and small equally abundant and intermixed.

Elytra about twice as long as wide, as wide as pronotum; sides straight and subparallel on anterior two-thirds, tapering and broadly rounded behind; striae feebly impressed except the first which is moderately impressed, punctures large, close, rather deep; interspaces slightly wider than striae, densely punctured, moderately granulate; pubescence of sparse moderately long fine hair. Declivity moderately arched, interspaces with medial rows of large granules; hair and scales sparse.

Type locality - California.

Distribution - British Columbia, south to California and east to Utah and New Mexico.

Hosts - The species of Pinus.

Hylurgops lecontei was described by Swaine (1917:16) from specimens collected in Colorado. Referring to this species Swaine (1918:82) writes, "Allied to porosus (Lec.) but smaller, with the pronotal punctures coarser and denser, and the striae less deeply impressed on the declivity."

Specimens were collected from the bark of the roots of a large partially dead Pinus flexilis at Beaver Creek Sept. 25, 1946, 8700 ft.; and from P. contorta at Amazon Mine June 14, 1947, 7200 ft. Only a fraction of these specimens are typical of either H. porosus or H. lecontei; some have the pronotal characteristics of H. porosus and the elytral

characteristics of H. lecontei, others have the pronotum decidedly characteristic of H. lecontei and the elytral characteristics of H. porosus. All of the specimens are considered as belonging to the same species and will here be referred to the older name of H. porosus.

Key to the Genera of Ipinas

- A. Eyes divided; antennal club without distinct sutures
 Trypodendron Stephens
- AA. Eyes not divided; antennal club with sutures at least at tip.
 - B. Pronotal asperities rather sparse, large, isolated; body clothed with scales (except Trypophloeus punctipennis); anterior margin of pronotum strongly produced medially.
 - C. Antennal funicle of four segments; club only slightly longer than wide.
 - D. Pronotum acutely margined at sides; elytra very feebly striate; eyes emarginate; in coniferous trees
 Cryphalus Erichson
 - DD. Pronotum not acutely margined at sides; elytra distinctly striate; in broadleaf trees
 Procryphalus Hopkins
 - CC. Antennal funicle of five segments; club much longer than wide; pronotal asperities smaller; in broadleaf trees . .
 Trypophloeus Fairmaire
- BB. Anterior margin of pronotum not usually produced; pronotal asperities small and numerous, sometimes granulate; body clothed with hair.
 - C. Pronotum with a fine elevated line at base and sides; metepisternum covered by elytra, visible only anteriorly.

- D. Antennal club not septate; pronotal asperities extending over more than anterior half, marginal granules almost obsolete; rather stout species.
- E. Segments one plus two of antennal club longer than segments three plus four; club and funicle subequal in length; ninth interspace not noticeably elevated; body very stout; in pine cones Conophthorus Hopkins
- EE. Segments one plus two of antennal club shorter than segments three plus four; club slightly longer than funicle; ninth elytral interspace elevated; body moderately stout; in pith of twigs Myeloborus Blackman
- DD. Club septate; pronotal asperities extending over only anterior half of pronotum; moderately stout to slender species; frons of female with long yellow hair Pityophthorus Eichhoff
- CC. Pronotum not margined behind; metepisternum visible for entire length.
 - D. Fore tibiae weakly dilated distally, with about four rather slender and widely placed teeth on the outer apical margin; declivity moderately to very strongly excavated, frequently with strongly elevated teeth; antennal club variously modified.
 - E. Frons of female deeply excavated; prosternum very short and oblique in front of coxae; declivity not at all separated from apical margin by an abrupt margin
. Pityogenes Bedel
 - EE. Frons not deeply excavated in either sex; prosternum long, acute, extending between coxae; declivity separated from apical margin by an elevation, frequently very weak.

F. Declivity strongly excavated, separated from apical margin by a strongly produced, horizontal plate-like acute margin; club flat, sutured only on one side Ips DeGeer

FF. Declivity not strongly excavated, elevation separating apical margin not strongly produced; antennal club thickened basally, usually obliquely truncate.

G. Frons sparsely clothed with rather short hair; elevation completely separating declivity from apical margin; antennal club longer than wide

. Orthotomicus Ferrarie

GG. Frons of female densely clothed with long fine yellow hair; marginal elevation absent toward middle, sutural sulcus reaching apex; antennal club wider than long. .

. Pityokteines Fuchs

DD. Fore tibiae strongly dilated distally, with a row of six or more closely placed, stout teeth on outer apical margin; declivity flat or very weakly sulcate, not excavated; antennal club obliquely truncate.

E. Pronotum subequally convex in front and behind, not declivitous, granulate over entire surface; declivity flattened, not granulate; found in bark Dryocoetes Eichhoff

EE. Pronotum declivitous in front, granules or asperities behind the summit absent; ambrosia beetles, work in wood.

F. Pronotum circular, anterior margin serrate; scutellum distinct; males convex, much smaller than females; larger species Anisandrus Ferrarie

FF. Pronotum oblong-quadrate, anterior margin not serrate, asperities small; scutellum either distinct or depressed; sexual differences not marked; smaller species

. Xyleborus Eichhoff

Trypodendron Stephens

Body stout, cylindrical; pronotum rather round; surface smooth and shining; eyes divided. Antennal funicle four segmented; club entire, with basal segment strongly angulated in front and produced toward the middle; metaepisternum strongly sinuate behind or inner side.

Key to the Species of Trypodendron

A. Third declivital interspace indistinctly elevated; elytra subacuminate behind; larger than 3.5 mm. long, color black; in Populus species T. retusus (LeConte)

AA. Third declivital interspace slightly elevated and uniserially punctate; pronotum with brown or reddish area posteriorly; less than 3.5 mm. long; in coniferous trees.

B. Second declivital interspace as wide as interspaces one and three, and distinctly punctate; elytra broadly rounded behind; pronotum and elytra with pale markings T. lineatum (Oliver)

BB. Second declivital interspace distinctly narrower than interspaces one and three, impunctate; elytra subacuminate behind; base of pronotum and the elytra brown. . . T. rufitarsus (Kirby)

Trypodendron retusus (Le Conte)

LeConte, J. L. (As Xyloterus) Am. Ent. Soc. Trans. 2:158, 1868.

Length 3.5 to 4.5 mm., 2.6 times as long as wide; shining, color black, sparsely clothed with long yellow hair.

Male - Frons very deeply concave from margins of eyes and epistoma to vertex, deepest between eyes; shining, very sparsely granulate; lateral margins with a row of long, fine, yellow hair. Eyes with upper and lower halves completely and widely separated. Antennal club entire, basal segment strongly angled in center and produced toward middle.

Pronotum 1.45 times as wide as long, subquadrate, straight on anterior margin, rather weakly transversely asperate before summit; sparsely, finely, feebly punctured behind.

Elytra 1.6 times as wide as long, as wide as pronotum; sides straight and subparallel on anterior two-thirds, narrowly rounded behind; striae feebly impressed, punctures very small; interspaces nearly flat, rather wide; disc glabrous, sides and declivity with sparse long yellow hair; second striae flat and depressed, feebly sulcate on declivity.

Female - Front convex, sparsely granulate; segments of antennal funicle and first two segments of club each with a long bristle on the inner edge.

Type locality - Canada.

Distribution - Canada south to West Virginia, west to the eastern slopes of the Rocky Mountains, also in Washington.

Hosts - Populus grandidentata, P. tremuloides.

A wood boring ambrosia beetle which is common in the bole of dead Populus tremuloides during the late summer months. Collected at Dry Canyon July 13, 1946, 6500 ft.; and Temple Fork July 21, 1946, 6500 ft.

Trypodendron lineatum (Oliver)

Oliver, A. G. (As Apate) Entomologie on Histoire Naturelle des Insects, Coleoptera 4:18, 1795.

Length 3.3 mm., 2.35 times as long as wide; color black with reddish-brown antennae, legs, and broad longitudinal markings on the pronotum and elytra; pubescence sparse.

Male - Frons deeply, broadly concave from inner margins of eyes and epistomal margin to vertex; shining, sparsely granulate; pubescence longer and more abundant on lateral margins. Eyes widely divided, into upper and lower halves. Antennal club large, oval.

Pronotum 1.32 times as wide as long, subquadrate, flattened on anterior margin; asperities transverse, small and numerous, covering the surface before summit; sides and base behind summit usually with small indistinct asperities; base reddish-brown except extreme lateral portions, the reddish-brown area extending in two branches anteriorly around the summit; pubescence confined to anterior and lateral areas.

Elytra 1.66 times as long as wide, shining, slightly narrower than pronotum; sides straight and parallel on anterior three-fourths, narrowly rounded behind; striae weakly impressed, punctures feebly impressed, indistinct, rather small, close; interspaces wider than striae and impunctate. Declivity with first, third and seventh interspaces convex and weakly elevated, second narrowed and depressed. First, fifth on disc, and lateral areas black, remaining areas reddish-brown. Pubescence of sparse short yellow hair, more abundant on the lateral areas.

Female - Frons convex; anterior margin of pronotum broadly rounded, asperities larger.

Type locality - Boreal America.

Distribution - "Widely distributed in the United States and Canada."

Chamberlin (1939) p. 301.

Hosts - Abies sp., Larix sp., Picea sp., Pinus sp., Tsuga sp., and Pseudotsuga sp.

Two specimens were collected deep in the wood of the bole of Abies lasiocarpa at West Hodge Creek May 17, 1947, 8000 ft.

Trypodendron rufitarsus (Kirby)

Kirby, W. F. (As Apate) Fauna Borealis Am. 4:193, 1837.

Length 3 to 3.6 mm., about 2.6 times as long as wide; color brown, except the anterior part of the pronotum which is black.

Male - Frons deeply, broadly concave from inner margins of eyes and epistomal margin to vertex; sparsely granulate, a very broad, feeble elevation from epistomal margin to bottom of the frontal concavity; pubescence longer and more abundant on lateral margins of the concavity. Eyes completely divided. Antennal club large, oval.

Pronotum 1.35 times as wide as long, subquadrate, straight on the anterior margin; asperities transverse, small, numerous, covering surface before summit, sides and base usually with minute asperities; color black with base brown; pubescence confined to the lateral and anterior areas.

Elytra 1.74 times as long as wide, shining, very slightly narrower than pronotum; sides nearly straight and subparallel to declivital origin, narrowly rounded behind; first and second striae weakly, others not impressed, punctures rather small, close, weakly impressed; interspaces wider than striae, very sparsely, finely, indistinctly punctured. Declivity with first and third interspaces feebly elevated, convex, uniserially punctate or granulate; second interspace narrower than first and third and impunctate. Pubescence short and sparse; color dark brown.

Female - Frons convex, more strongly granulate, with a weakly elevat-

ed, narrow, longitudinal carina on lower half. Anterior margin of pronotum broadly rounded, the asperities larger.

Type locality - Canadian Rockies.

Distribution - Western Ontario to northern Manitoba, south into the northern United States.

Hosts - Pinus resinosa, P. contorta, and Picea sp.

Rare in the wood of the bole of Pinus contorta in Logan Canyon. Collected at Amazon Mine June 11, 1947, 7200 ft.

Cryphalus Erichson

Hopkins (1915B:39) characterizes the genus as, "Antennal funicle 4-jointed, joint 4 broader; club compressed, broad, with sides equally rounded, sinuate, apex broadly rounded, with three slightly recurved sutures on anterior face and three broadly procurved sutures on posterior face; eyes short, oval, narrowly but distinctly emarginate. The male is slightly smaller than the female and its front is narrower."

Cryphalus ruficollis Hopkins

Hopkins, A. D. U.S.D. A., Office of Sec., Rep. 99:40, 1915.

Hopkins original description is, "Length, female type, 1.85 mm.; body suboblong, elliptical, dark brown; pronotum with rugose space reddish, anterior margin with four or five closely placed teeth, rugosities coarse, sparse, confused; front faintly transversely impressed, with median shining line and space, posterior and lateral punctures distinct; elytral striae distinct, faintly impressed on the median and lateral areas, declivity oblique, with striae scarcely evident, apex not broadly rounded. Alta, Utah, June 29; Hubbard and Schwarz collection. Type Cat. No. 7403, U. S. National Museum."

Thatcher (1947) collected this rare species at the head of Spring Hollow Sept. 9, 1934, and May 25, 1935, from Abies lasiocarpa. The first of these collections was listed by Knowlton and Nye (1939). Both collections were identified by Dr. M. W. Blackman.

Procryphalus Hopkins

Hopkins (1915b:33) describes the genus as, "Antennal funicle 4-jointed, joint 4 broader than 2 and closely jointed to base of club, which is oblong, elliptical, narrowed toward base, sides broadly rounded, faintly sinuate, anterior face with three straight sutures, posterior face without sutures; eyes oblong, not emarginate."

Procryphalus populi Hopkins

Hopkins, A. D. U.S.D.A., Office of Sec., Rep. 99:34, 1915.

Length 2.15 mm., 2.6 times as long as wide; color piceous-black, densely clothed with minute scales.

Frons moderately flattened with a broad, weakly elevated, median, longitudinal carina; feebly granulate-punctate; finely subreticulate above and on sides behind eyes; sparsely clothed with very fine long yellow hair. Eyes about twice as long as wide, oval, weakly sinuate on inner margin. Antennal funicle four segmented; club rather large, compressed, oval, narrowed basally, with three obscure, straight sutures on anterior face, sutures procurved on posterior face, not septate,

Pronotum about as wide as long, circular with anterior margin strongly produced; asperities large, isolated, two large very prominent apical, and two or three smaller subapical teeth medially on anterior margin; summit at middle, not strongly elevated; very finely, closely punctured behind summit, partially concealed by numerous minute scale-

like hairs, hair normal at sides and before summit.

Elytra 1.86 times as long as wide, slightly wider than pronotum, sides straight and subparallel on basal two-thirds, moderately broadly rounded behind; striae feebly impressed, punctures small, shallow, very close; pubescence of dense minute gray scales, almost concealing surface, interspaces rather wide, each with a row of sparse long bristle-like scales; ninth interspace feebly elevated posteriorly; apical margin of declivity with several long scale-like hairs.

Type locality - Tercio, Colorado.

Distribution - Colorado (also from Nevada in author's collection).

Hosts - Populus tremuloides.

Common just under the surface of the outer bark of the bole of dead Populus tremuloides. Collected at Dry Canyon July 13, 1946, 8000 ft.; and Temple Fork July 21, 1946, 6500 ft. (Det. W. H. Anderson).

Trypophloeus Fairmore

Species usually less than 2 mm. long. Antennal funicle five segmented, fifth segment broad; club oval, elongate and compressed, with three distinct, nearly straight sutures on anterior face, sutures indistinct or absent on posterior face. Eyes oval, usually narrowly emarginate. Pronotum produced moderately on anterior margin, with a few prominent teeth medially. Elytra feebly striate, with or without punctures. Pubescence of hair and scales, except T. punctipennis in which scales are almost entirely lacking.

Key to the Species of Trypophloeus

- A. Elytral disc distinctly punctured, and slightly wider than pronotum; pubescence of hair only; in Salix T. punctipennis Hopkins

AA. Elytra punctured only at base and sides; pronotum as wide as
elytra; pubescence of hair and scales; in Populus
. T. populi Hopkins

Trypophloeus punctipennis Hopkins

Hopkins, A. D. U.S.D.A., Office of Sec., Rep. 99:37, 1915.

Length 1.65 to 1.95 mm., 2.6 times as long as wide; shining, black,
clothed with fine, short hair; scales absent.

Frons with epistoma feebly elevated, smooth and shining; median line
impressed, deeper at epistomal base, faintly or not at all on vertex;
impression smooth and shining between eyes; coarsely, sub-granulately
punctured, punctures large and very shallow, reticulated above. Eyes
1.6 times as long as wide, oval, not emarginate. Antennal funicle five
segmented, fifth segment wide; club elongate-oval with three indistinct
sutures.

Pronotum about 1.1 times as wide as long, only moderately produced
in front; anterior margin with six to eight teeth, decreasing in size
from the two median ones; widest at base, sides weakly arcuate and narrow-
ed anteriorly, moderately narrowly rounded in front; asperities large,
isolated, transverse; summit behind middle, moderately elevated; large
and shallow to rather deeply, closely punctured behind summit; pubescence
of short yellow hair.

Elytra 1.8 times as long as wide, shining, slightly wider than pro-
notum, sides nearly straight and subparallel on anterior two-thirds mod-
erately rounded behind; striae feebly impressed only on sides, punctures
small, distinct, shallow, deeper on sides, separated by their own diamet-
ers; interspaces slightly wider than striae; pubescence of fine, very

short yellow hair, each interspace with a row of erect hair, longer than that of striae. Decivity gradually arched; punctures reduced to absent; pubescence as on the disc, but more nearly like scales.

Type locality - Alta, Utah.

Distribution - Only the type series is reported in the literature.

Hosts - Previously unknown.

An uncommon species which breeds just under the surface of the outer bark of the living boles and large limbs of Salix scouleriana. This species is capable of killing the host, usually girdling the bole with scar-like tissue produced by a fungus which is associated with the species. Collected at Card Canyon July 17, 1946, 7000 ft. (Det. W. H. Anderson); and at Little Bear Hollow May 17, 1947, 8000 ft.

Trypophloeus populi Hopkins

Hopkins, A. D. U.S.D.A., Office of Sec., Rep. 99:37, 1915.

Length 1.8 to 2.1 mm., 2.4 times as long as wide; color brown to black, clothed with numerous minute gray scales and short sparse hair.

Frons flattened, finely granulate-punctate, more strongly at sides; pubescence of sparse, rather long hair. Eyes about 1.8 times as long as wide, oval, very finely, narrowly emarginate on inner margin. Antennal club elongate-oval with three nearly straight sutures.

Pronotum 1.18 times as wide as long, moderately produced in front, with four prominent median teeth; widest basally, sides rather strongly arcuate and narrowed anteriorly; asperities large, isolated, transversely impressed; summit behind middle, moderately elevated; punctures behind summit small, shallow, close, slightly roughened on disc; sparsely covered with fine hair before summit and on sides.

Elytra 1.7 times as long as wide, as wide as pronotum; sides straight and subparallel on anterior two-thirds, moderately broadly rounded behind; striae visible only at base and on sides, punctures very small and shallow, separated by their own diameters, hardly visible posteriorly; interspaces more than twice as wide as striae where visible, minutely, closely punctured; pubescence of minute densely placed gray scales, each interspace with a row of longer scales. Declivity gradually arched, first and second striae usually faintly impressed; scales larger and more numerous.

Type locality - Williams, Arizona.

Distribution - Only the type series is reported in the literature.

Hosts - Populus tremuloides.

A rare species found in the outer bark of Populus tremuloides.
Collected at Dry Canyon July 13, 1946, 6500 ft. (Det. W. H. Anderson).

Conophthorus Hopkins

Body stout, cylindrical. Antennal funicle five segmented; club compressed, not septate, segments one plus two longer than segments three plus four; club and funicle subequal in length. Eyes acutely emarginate. Pronotum finely margined behind and at sides; anterior marginal serrations almost obsolete; sides rugose on more than the anterior half.

Conophthorus flexilus Hopkins

Hopkins, A. D. Jour. Wash. Acad. Sci. 5:433, 1915.

Length 3 to 3.8 mm., 2.7 times as long as wide; color dark brown to dull black, sparsely covered with fine, long yellow hair; head usually completely withdrawn into the pronotum.

Frons convex above, narrowly flattened above epistomal base, with a very feeble longitudinal carina on lower portion; punctures large, deep, moderately close; pubescence mostly limited to epistomal margin. Eyes oval, triangularly emarginate, one-third divided. Antennal funicle five segmented; club non-septate.

Pronotum about as long as wide, widest basally, narrowed anteriorly and rather narrowly rounded in front; asperities numerous, rather low, extending beyond middle at sides; punctures large, deep, rather close; pubescence of short sparse yellow hair.

Elytra 1.4 times as long as wide, wider than pronotum; sides nearly straight and subparallel on anterior half, broadly rounded behind; striae feebly impressed, punctures small, deep, separated by their own diameters, in obscure rows, smaller and shallower laterally; interspaces shining, twice as wide as striae, punctures sparse, as large as and similar to those of striae; pubescence of very sparse, long yellow hair. Declivity very broadly, weakly sulcate, third interspace elevated and with a few small setose granules; sulcus faintly or not at all punctured, glabrous, shining, and obsolete before the apex.

Type locality - Mount Manitou, Colorado.

Distribution - Colorado and Utah.

Hosts - Pinus flexilis.

Common in the cones of Pinus flexilis which fall to the ground prematurely. Collected at Beaver Creek July 26, 1946, 8500 ft.; and the Summit of Logan Canyon Aug. 9, 1946, 8000 ft.

Knowlton and Nye (1939) also report this species from Logan Canyon.

Nyeloborus Blackman

Body moderately stout. Antennal funicle of five segments; club non-septate, segments one plus two shorter than segments three plus four; club slightly longer than funicle. Pronotum not evenly convex, transversely impressed behind summit; anterior margin weakly serrate; asperities extending behind middle at sides. Ninth elytral interspace elevated.

Myeloborus pinquis Blackman

Blackman, M. W. Bull. N. Y. Coll. For., Vol. 1, No. 36, Tech. Pub. 25:20, 1928. The following description was adapted from the original.

Body stout; color black, sparsely pubescent.

Female - Length 2 mm., 2.46 times as long as wide. Frons convex, slightly flattened, deeply coarsely, rather roughly punctured; scanty pubescence of very fine short hair. Eyes oval, narrowly, deeply emarginate on inner margin. Antennal club oval, 1.18 times as long as wide, sutures slightly curved, non-septate.

Pronotum very slightly wider than long; sides distinctly arcuate posteriorly, narrowed in front of middle, narrowly rounded in front, with six to nine small acute serrations; asperities small and numerous in irregular concentric rows; posterior area with deep, moderately large punctures, rather close laterally; median line broad, feebly elevated at impression behind summit and impunctate.

Elytra 1.6 times as long as wide, shining, wider than pronotum; sides straight and subparallel to declivital origin, rather broadly rounded behind; striae punctures rather fine, deep, in approximate rows; interspaces with very few punctures; pubescence of fine short hair aris-

ing from stria punctures, and a few slightly longer ones from interspatial punctures. Declivity gradually arched; sulcus wide, very shallow, shining; suture weakly elevated, with feeble granules near apex; first and second striae impunctate; third interspace very slightly elevated, with faint traces of granules. Ninth interspace moderately elevated on sides.

Male - Shorter, 1.57 mm. long, 2.32 times as long as wide; frons more coarsely, roughly punctate, with an indefinite longitudinal carina; declivity more abrupt.

Type locality - Colorado

Distribution - Colorado, New Mexico, and Arizona.

Hosts - Pinus flexilis, and P. strobiformis.

Specimens in the Utah State Agricultural College insect collection were collected from Pinus flexilis in Logan Canyon Aug. 2, 1934 by T. O. Thatcher, and March 8, and April 12, 1936, and May 2, 1937 by R. E. Nye (Det. W. H. Anderson).

Pityophthorus Eichhoff

Body small, cylindrical, elongate, pubescent; female with numerous long hairs on front. Antennal funicle five segmented; club oval, septate. Asperities of pronotum not extending beyond middle; pronotum finely margined behind and on sides. Elytra punctate, declivity sulcate.

Key to the Species of Pityophthorus

- A. Male with an acute, elevated, longitudinal, frontal carina;
female frons usually flattened on a small area and covered with fine long hair, usually with an indistinct carina; declivital sulcus shallow, granules minute; elytra broadly rounded behind.

- B. Second declivital interspace punctured; antennal sutures straight; smaller than 1.7 mm. P. inquietus Blackman
- BB. Second declivital interspace impunctate; antennal sutures distinctly procurved; larger species than 1.7 mm.
- C. Elytral punctures fine; declivital sulcus narrow, weak; lateral granules minute. P. demissus Blackman
- CC. Elytral punctures distinctly impressed, rather large; declivital sulcus very wide, rather deep and shining, granules distinct on suture and lateral margins; larger, stouter species P. opimus Blackman
- AA. Male with an elevated transverse carina, frequently with a dorsally directed extension; female with frons flattened and ornamented with long yellow hair; declivital sulcus rather deep, with distinct lateral granules; elytra broadly rounded to strongly acuminate behind.
- B. Male with transverse carina, with a dorsal extension; elytra broadly rounded behind; interstitial punctures absent.
- C. Male with carina short and rather weakly elevated; female with frons feebly concave, smooth and shining, fringed with long yellow hair; pronotum narrowly rounded in front, marginal teeth longer medially P. tuberculatus Eichhoff
- CC. Male with carina rather long, distinctly elevated; female with frons flat, subopaque, completely covered with long yellow hair; pronotum broadly rounded in front, marginal teeth not longer medially. P. pseudotsugae Swaine
- BB. Male without a distinct dorsal extension on transverse carina; elytra subacuminate behind.
- C. Elytral punctures rather irregular to confused; interstitial punctures rather numerous.

- D. Elytral punctures strongly confused; pronotum moderately closely, coarsely punctured; frontal pubescence of female coarser and less abundant
 P. confertus Swaine
- DD. Elytral punctures in approximate rows posteriorly; pronotum finely, rather sparsely punctured; frontal pubescence of female finer, more numerous.
 P. burkei Blackman
- CC. Elytral punctures in rows; interspaces almost impunctate.
- D. Pronotal asperities not fused to form concentric ridges; second declivital striae impunctate; declivital teeth small.
- E. Both sexes more than three times as long as wide.
- F. Frontal hair of female very long, shorter toward the epistoma . . . P. gracilis Swaine
- FF. Frontal hair of female shorter and of equal length throughout. P. exilis Swaine
- EE. Male less than three times as long as wide
 P. bassetti Blackman
- DD. Pronotal asperities fused to form concentric ridges; second declivital striae punctured; declivital teeth large
 P. virilis Blackman

Pityophthorus inquietus Blackman

Blackman, M. W. Bull. N. Y. State Coll. For., Vol. 1, No. 36, Tech. Pub. 25:46, 1928.

Type locality - Las Vegas, New Mexico.

Distribution - New Mexico.

Hosts - Pinus edulis.

Abundant in the small twigs of pine. Collected at Dry Canyon July 19, 1946, 5500 ft. in Pinus monophylla; Beaver Creek July 26, 1946, 8000 ft. in P. flexilus (Det. W. H. Anderson)

Pityophthorus demissus Blackman

Blackman, M. W. Bull. N. Y. State Coll. For., Vol. 1, No. 36, Tech. Pub. 25:74, 1928.

Type locality - Glacier National Park, Montana.

Distribution - Montana, and Utah.

Hosts - Abies lasiocarpa.

A common species in branches and seedlings of Abies lasiocarpa 0.5 to 1 inch in diameter. Collected at Logan Cave Dec. 31, 1945, 6200 ft.; and Franklin Basin July 24, 1946, 8000 ft. (Det. W. H. Anderson).

Pityophthorus optimus Blackman

Blackman, M. W. Bull. N. Y. State Coll. For., Vol. 1, No. 36, Tech. Pub. 25:80, 1928.

Type locality - Captain Mountains, New Mexico.

Distribution - New Mexico, and Colorado.

Hosts - Picea engelmanni, and Pinus flexilus.

This is an uncommon species which is found in the small branches and twigs of Pinus flexilus in Logan Canyon, frequently found boring in the pith. Collected at Beaver Creek July 26, 1946, 8000 ft. (Det. W. H. Anderson).

Pityophthorus sp. near mundus Blackman

Reported by Thatcher (1935) at Wood Camp Sept. 2, 1934, from

Pinus flexilus. Nothing more is known of this species.

Pityophthorus tuberculatus Eichhoff

Eichhoff, W. Mem. Soc. Royal Sci. de Liege p. 498, 1878. Re-described by Elackman (1928) p. 92.

Type locality - California.

Distribution - South Dakota south to New Mexico and Texas, west to the Pacific Coast.

Hosts - Pinus ponderosa, and P. contorta.

An abundant species in the bark of branches and broken tops of Pinus contorta. Collected at Amazon Mine June 13, July 5, and Aug. 9, 1946, 7200 ft.; and the Summit of Logan Canyon Aug. 9, 1946, 8000 ft. (Det. W. H. Anderson).

This species was also reported by Knowlton and Nye (1939).

Pityophthorus pseudotsugae Swaine

Swaine, J. M. Dom. Can. Dept. Agr. Ent. Br. Bull. 14(2):100, 1918. Redefined by Elackman (1928) p. 106.

Type locality - Vernon, British Columbia.

Distribution - Western Canada, Oregon, Idaho, Washington, California, Utah, Colorado, and Montana.

Hosts - Pseudotsuga taxifolia, Abies grandis, A. concolor, A. magnifica, A. lasiocarpa, and A. nobilis.

An abundant species collected from the bark of the bole of Abies lasiocarpa. Collected at Dry Canyon June 16, 1946, 6500, and 8000 ft., and again June 29, 1946, 6500, and 8000 ft.; Franklin Basin July 5, 1946, 7300 ft., and July 24, 1946, 8000 ft.; and the Summit of Logan Canyon Aug. 9, 1946, 8000 ft. (Det. W. H. Anderson).

Thatcher (1935) reported a collection (?) from Pinus contorta (murrayana used by Thatcher). Knowlton and Nye (1939) also reported this species.

Pityophthorus confertus Swaine

Swaine, J. M. Dom. Can. Dept. Agr. Ent. Br. Bull. 14(1):27, 1917. Redescribed by Blackman (1928) p. 122.

Type locality - Adams Lake, British Columbia.

Distribution - British Columbia, Washington, Idaho, Oregon, California, Colorado, New Mexico, Arizona, and Utah.

Hosts - Pinus edulis, P. jeffreyi, P. ponderosa, P. contorta, and Abies grandis.

Common in Logan Canyon in the bark of the bole of Pinus contorta. Collected at Amazon Mine June 5, and again June 13, 1946, 7200 ft.; and the Summit of Logan Canyon Aug. 9, 1946, 8000 ft. (Det. W. H. Anderson).

This species was also reported by Knowlton and Nye (1939).

Pityophthorus burkei Blackman

Blackman, M. W. Bull. N. Y. State Coll. For., Vol. 1, No. 36, Tech. Pub. 25:129, 1928.

Type locality - Meyers, California.

Distribution - California, Utah, and Idaho.

Hosts - Pinus contorta, and P. ponderosa.

This species was reported by Knowlton and Nye (1939) from Beaver Creek June 28, 1938, from Pinus contorta, collected by A. D. Smith. Two female specimens have been examined in this study.

Pityophthorus gracilis Swaine

Swaine, J. M. Can. Ent. 57:195, 1925. Blackman (1928) p. 134.

Type locality - Grant County, Oregon.

Distribution - Oregon, Idaho, Utah, Montana, Wyoming, and Manitoba.

Hosts - Pinus contorta.

An uncommon species collected from the bark of the bole of Pinus contorta at Amazon Mine June 13, 1946, 7200 ft.; the Summit of Logan Canyon Aug. 9, 1946, 8000 ft.; and the Summit of West Hodge Creek June 13, 1947, 8500 ft. (Det. W. H. Anderson).

This species was reported by Knowlton and Nye (1939) and includes the specimens reported by them as P. exilis Swaine.

Pityophthorus basseti Blackman

Blackman, M. W. Bull. N. Y. State Coll. For., Vol. 1, No. 36, Tech. Pub. 25:136, 1928.

Type locality - Pitkin, Colorado.

Distribution - Colorado

Hosts - Picea engelmanni.

An uncommon species found in the bark of dead branches of Picea engelmanni at Franklin Basin July 24, 1946, 8000 ft. (Det. W. H. Anderson).

Pityophthorus virilis Blackman

Blackman, M. W. Bull. N. Y. State Coll. For., Vol. 1, No. 36, Tech. Pub. 25:143, 1928.

Type locality - Vermego, New Mexico.

Distribution - New Mexico, Colorado.

Hosts - Rhus copallina.

Common in the bark of branches of Rhus trilobata at the lower elevations. Collected at Dry Canyon Dec. 23, 1945, 5000 ft.; and

the mouth of Logan Canyon March 17, 1946, 4800 ft. (Det. W. H. Anderson).

Pityogenes Bedel

Body moderately stout, sparsely pubescent, cylindrical. Antennal funicle five segmented; club flattened, sutured on both sides. Pronotum strongly asperate anteriorly, punctate behind; prosternum short, intercoxal process wide and short. Elytra striate-punctate; declivity moderately excavated. Male with prominent declivital teeth; female with deeply excavated frons.

Key to the Species of Pityogenes

- A. Declivity oblique, three teeth on each side; pronotum narrowly rounded in front; frontal pit of female large, very deep, circular, undivided P. fossifrons (LeConte)
- AA. Declivity steep, two teeth on each side, very long and recurved in male; pronotum broadly rounded in front; frontal pit of female divided by a median carina.
 - B. Declivital teeth of male very long and slender, directed above the plane of the disc; frontal pit of female large, deep, heart-shaped; larger species . . P. knechteli Swaine
 - BB. Declivital teeth of male stout, not directed above the plane of the disc; frontal pit of female small, shallow, the pubescent area larger; smaller species
 P. near plagiatus (LeConte)

Pityogenes fossifrons (LeConte)

LeConte, J. L. (As Pityophthorus) Proc. Am. Phil. Soc. 15:353, 1876.

Length 1.9 to 2.5 mm., 2.8 times as long as wide; color brown to black, moderately pubescent.

Male - Frons moderately convex, with a feebly elevated median carina; punctures moderately large, very close; covered with very fine, short, yellow hair. Eyes oval, about twice as long as wide, feebly sinuate on inner margin. Antennal club as wide as long.

Pronotum 1.14 times as long as wide, smooth and shining, as wide as pronotum, sides straight and subparallel on posterior half, narrowly rounded in front, asperities numerous, small; posterior half shining, moderately punctured, punctures rather small, moderately close; median line narrowly elevated, impunctate; sparsely covered with fine, moderately long yellow hair.

Elytra 1.5 times as long as wide, smooth and shining, as wide as pronotum; sides straight and subparallel on anterior three-fourths, broadly rounded behind; striae not impressed, punctures minute, in indistinct rows; discal pubescence of very sparse stout long erect hair, short and fine on sides. Declivity gradual, with three elevated, very stout pointed teeth; pubescence sparse and minute.

Female - Frons with very large, deep, conical concavity occupying the central half between eyes; area below concavity appears spongy, lighter color. Declivital teeth reduced to pointed tubercles.

Type locality - British Columbia.

Distribution - British Columbia to California, east to Idaho.

Hosts - Pinus monticola, and P. contorta.

A common species collected from the bark of limbs four to eight inches in diameter of Pinus flexilis at Beaver Creek July 26, 1946, 8000 ft. (Det. W. H. Anderson), and again June 14, 1947, 7500 ft.; and Amazon Mine June 14, 1947, 7200 ft. from P. contorta.

Pityogenes knechteli Swaine

Swaine, J. M. Dom. Can. Dept. Agr. Ent. Br. Bull. 14(2):106, 1918.

Length 1.8 to 3 mm., about 2.7 times as long as wide; color brown to black, moderately pubescent.

Male - Frons weakly convex, granulate-punctate, epistomal carina small; sparse, moderately long pubescence. Eyes oval, about twice as long as wide, weakly sinuate on inner margin. Antennal club sutured on both sides.

Pronotum as long as wide, sides nearly straight and subparallel on posterior half, constricted at sides anteriorly; rather broadly rounded in front; finely, rather sparsely, shallowly punctured behind, shining; median line impunctate, narrowly elevated from summit to base; pubescence confined to sides and anterior margin.

Elytra about 1.4 times as long as wide, shining, as wide as pronotum; sides straight and subparallel on basal three-fourths, truncate behind; striae not impressed, punctures very small and in rows, separated by twice their own diameters, those of interspaces nearly as large and as numerous as on striae. Declivity strongly convex, margins elevated, with a long slender recurved tooth at top, and a smaller, stout, pointed tooth at bottom; apical margin not elevated. Elytral pubescence of rather long, fine yellow hair.

Female - Frons with a large, very deep, heart-shaped concavity placed medially between the eyes; concavity divided longitudinally by a carina. Declivity deeply sulcate, with two small, acute teeth on each lateral margin.

Type locality - Jasper Park, Alberta.

Distribution - Alberta to British Columbia, south to north-western United States.

Hosts - Pinus contorta, and P. monticola.

An abundant species in the bark of cut and broken limbs and branches of Pinus contorta. Collected at Amazon Mine July 5, 1946, and again June 14, 1947, 7200 ft.; and Beaver Creek July 26, 1946, 7400 ft.

This species was also reported by Knowlton and Nye (1939).

Pityogenes near plagiatus (LeConte)

A species, apparently undescribed, belonging to the genus Pityogenes was collected during this study. Because only a few specimens have been collected the description of this species will not be included here, but will be published later when more material is available.

Ips DeGeer

Body cylindrical, moderately slender to stout. Antennal funicle of five segments; club flattened, sutured on only one side. Pronotum strongly asperate in front, punctured behind. Declivity concave, separated from the apical margin by a strongly elevated horizontal plate-like extension. Intercostal process long and acute.

Key to the Species of Ips

- A. Sutures of antennal club very strongly arcuate; punctures of elytral striae and interspaces about equal in size and number . . .
 I. radiatae Hopkins
- AA. Sutures of antennal club straight or bisinuate; striae punctures more numerous and usually larger than interspaces punctures.
- B. Sutures of antennal club nearly straight; declivity with three marginal teeth; interspaces punctures small, regularly placed; less than 3.5 mm. long.

- C. Female without frontal carina; the declivital teet smaller, a ridge of three cusps following the second
 I. latidens (LeConte)
- CC. Female with frontal carina; declivital teeth large, second followed by two cusps I. guildi Blackman
- BB. Sutures of antennal club bisinuate; declivity with four marginal teeth; interspacial punctures absent, or more closely placed near declivity than at base; larger species, over 4 mm. long.
- C. Interspaces impunctate except posterior third of second which is confused with second striae I. oregoni Eichhoff
- CC. Interspaces punctured throughout, more closely near declivity; first interspace weakly granulate, second granulate only near declivital origin I. near interruptus (Mannerheim)

Ips radiatae Hopkins

Hopkins, A. D. Proc. Ent. Soc. Wash. 17:54, 1915.

Length 4 to 5 mm., 2.6 times as long as wide; color brown to black, moderately pubescent.

Male - Frons coarsely granulate, with epistomal margin deeply emarginate, and with a large elevated tooth placed medially; deeply concavely impressed on median line between eyes; median line smooth and shining; pubescence of very long yellow hair. Eye ovate, about three times as long as wide. Antennal club longer than wide, sutures very strongly arcuate.

Pronotum 1.1 times as long as wide, shining, sides straight and subparallel on posterior half; punctures of medium size, close, rather deep; median line feebly, broadly elevated and impunctate; pubescence

of rather abundant long yellow hair.

Elytra 1.67 times as long as wide, shining, about as wide as pronotum; sides straight and subparallel to declivital origin, truncate behind; first striae moderately, others feebly impressed, punctures of moderate size and rather close; interspatial punctures as large and as numerous as those of striae. Declivital concavity wide, deeply, closely punctured, suture weakly elevated; margin elevated, with three teeth, third tooth very large and prominent. Elytral pubescence rather abundant, of fine, very long yellow hair.

Female - Frontal concavity not as deep, granules smaller, and the declivital teeth smaller than in the male.

Type locality - Berkeley, California.

Distribution - British Columbia to southern California, east to Idaho, Wyoming, and Utah.

Hosts - Pinus radiata, P. contorta, P. jeffreyi, P. albicaulis, P. muricata, and P. attenuata.

A common species collected in the bark at the base of the bole of Pinus contorta. Collected at the Summit of Logan Canyon Aug. 9, 1946, 8000 ft. (Det. W. H. Anderson); the Summit of West Hodge Creek June 13, 1947, 8500 ft.; and Amazon Mine June 14, 1947, 7200 ft.

Knowlton and Nye (1939) also reported this species.

Ips latidens (LeConte)

LeConte, J. L. (As Tomicus) Am. Ent. Soc. Trans. 5:72, 1874.

Length 2.7 to 3.5 mm., 2.8 times as long as wide; color brown to black, moderately pubescent.

Male - Frons roughly granulate-punctate above and on sides; rather flattened below with a few large granules; epistomal margin broadly, shallowly emarginate and bearing a fringe of ventrally directed short

yellow hair; frontal pubescence of long, sparse, fine yellow hair. Eyes ovate, deeply sinuate on inner margin. Antennal club about as wide as long, with two weakly arcuate sutures on anterior face.

Pronotum 1.2 times as long as wide, sides straight and subparallel on basal two-thirds, broadly rounded anteriorly; asperities small, numerous, covering anterior half; punctures of medium size, close, rather shallow; pubescence longer and more numerous on sides.

Elytra 1.7 times as long as wide, as wide as pronotum; sides straight and subparallel to declivital origin, truncate behind; striae one and two moderately impressed, others feebly; strial punctures rather large, close, very deep, reduced in size toward base; interspaces as wide as striae, punctures fine, shallow, confused, about as numerous as strial punctures. Declivity abrupt, concavity wide with rather large, close, deep punctures; margins strongly elevated and bearing three teeth; first tooth small, acute; second stout, followed by a ridge of three confluent cusps; third long and acute, separated from, but followed by an acute apical margin.

Female - Frontal sculpturing finer; declivital teeth smaller.

Type locality - California.

Distribution - British Columbia to California, east to Utah.

Hosts - Pinus ponderosa, P. lambertiana, P. jeffreyi, P. contorta, P. sabaliana, and P. monticola.

Common in the bark of the bole and large limbs of pine. Collected at Beaver Creek July 26, 1946, 8000 and 8500 ft. from Pinus flexilis; and the Summit of Logan Canyon Aug. 9, 1946, 8000 ft., and Amazon Mine June 14, 1947, 7200 ft. from P. contorta.

This species was also reported by Thatcher (1935) and Knowlton and Nye (1939).

Ips guildi Blackman

Blackman, M. W. Bull. N. Y. State Coll. For., Vol. 1, No. 36, Tech. Pub. 16:137, 1922. The following description was adapted from the original.

Length 2.7 to 3.5 mm., 2.88 times as long as wide; color reddish brown to black.

Female - Frons flattened below, granulate-punctate, with epistoma widely, deeply emarginate, and with yellow hair; convex above, densely coarsely, roughly punctured with an impunctate elevated median carina; pubescence of short, sparse hair. Eyes with inner margin broadly, shallowly emarginate. Antennal club with first suture straight, recurved at sides, second suture bisinuate.

Pronotum 1.17 times as long as wide, sides subparallel on basal half, broadly rounded in front; anterior half densely, coarsely asperate, transversely depressed and densely granulate just behind summit except on median line; disc shining, sparsely punctured, sides more coarsely and closely punctured; pubescence confined to asperate area and sides.

Elytra 1.75 times as long as wide, wider than pronotum; sides straight and subparallel to declivital origin, truncate behind; striae impressed, punctures coarse, deep, close; interspaces rather narrow, with fewer, finer punctures, uniseriably placed, larger toward the declivity where strial and interspatial punctures become confused. Declivity abrupt, deeply, coarsely, closely punctured, suture elevated, margin with three teeth; first directed caudad-mesad; second longer, curved, directed similar to first, followed by a ridge of two confluent cusps; third slightly larger than second, only slightly curved;

pubescence abundant and moderately long.

Male - Without frontal carina, sculpture coarser, declivital teeth longer coarser and more curved.

Type locality - Grand Lake, Colorado.

Distribution - Colorado.

Hosts - Pinus murrayana.

Two specimens were collected from a Dendroctonus killed Pinus contorta at Amazon Mine July 13, 1946, 7200 ft. (Det. W. H. Anderson).

Ips oregoni (Eichhoff)

Eichhoff, W. (As Tomicus) Berl. Ent. Zeit., p. 274, 1868

Length 3.3 to 4.3 mm., 2.5 times as long as wide; color brown to black, shining, sparsely pubescent.

Male - Frons convex, covered with rather closely placed, large granules and a large tubercle medially placed between the eyes; pubescence of sparse, long fine yellow hair, and a short epistomal fringe. Eyes oval, about three times as long as wide, strongly sinuate on inner margin. Antennal club oval, longer than wide, sutures besinuate on anterior face.

Pronotum 1.1 times as long as wide, shining, sides straight and subparallel on basal two-thirds, very broadly rounded in front; asperities rather small and numerous on anterior half; punctures small and close on disc, larger and more widely separated dorsolaterally, very close and subgranulate on sides; pubescence of fine long yellow hair, confined to the sides and anterior margin.

Elytra 1.4 times as long as wide, shining, as wide as pronotum; sides straight and subparallel on anterior half, weakly arcuate post-

eriorly, truncate behind; first striae moderately, others feebly impressed, punctures rather small, reduced near base and near declivity; interspaces about twice as wide as striae, and impunctate except posteriorly on second interspace where punctures are confused with first striae. Declivity abrupt, punctures small, close, deep; suture elevated; margin bearing four teeth, first small, acute; second larger, stout and basally connected to third; third long, prominent, capitate; fourth small, stout. Elytral pubescence confined to sides and declivital margins.

Female - Frons more finely granulate; declivital teeth smaller.

Type locality - Oregon.

Distribution - Western United States and western Canada.

Hosts - Pinus ponderosa, P. contorta, P. jeffreyi, P. lambertiana, and P. sabiniana.

An abundant species in the bark of cut and dying large limbs and boles of Pinus contorta. Collected at Amazon Mine June 13, 1946, 7200 ft.; and Beaver Creek July 26, 1946, 7400 ft.

Thatcher (1935) and Knowlton and Nye (1939) also reported this species.

Ips near interruptus (Mannerheim)

A species, apparently undescribed, belonging to the genus Ips was collected during this study. A description of this species will not be included here, but will be published at a later date.

Orthotomicus Ferrarie

Body cylindrical, rather slender; frons without long hair in female. Antennal funicle five segmented; club longer than wide, thickened basally, and obliquely truncate. Declivity rather feebly concave, with posterior marginal extension weakly elevated, acute and separating the concavity from the apical margin.

Orthotomicus lasiocarpi Swaine

Swaine, J. M. Can. Ent. 48:183, 1916.

Length 1.7 to 2.3 mm., 2.9 times as long as wide; color reddish to dark brown, pubescent.

Male - Frons convex, densely, rather coarsely punctured below, sparsely punctured toward vertex; very feebly broadly carinate on caudal two-thirds; rather weakly transversely impressed on epistoma; pubescence of fine, rather sparse short hair. Eyes oval, emarginate. Antennal club slightly longer than wide, rather obliquely truncate on distal half of anterior face, but with two sutures visible on posterior face, the first four-fifths of the distance from the base, the second at the tip.

Pronotum 1.14 times as long as wide, widest posteriorly, with sides weakly arcuately narrowed anteriorly, broadly rounded in front; asperities very small, dense on anterior half, becoming obsolete on sides, anterior margin without asperities; punctures moderately deeply, closely placed, dense on sides; median line smooth, feebly, narrowly carinate from summit to base; pubescence of abundant short, fine, yellow hair.

Elytra 1.83 times as long as wide, slightly wider than pronotum; sides straight and subparallel to declivital origin, very broadly rounded behind; first striae feebly, others not at all impressed, punctures very small, rather deep, separated by their own diameters; interspaces about twice as wide as striae, punctures finer and almost as closely placed as those of striae, finely granulate toward declivity. Declivity shining, rather steep; sutural striae rather deeply, widely sulcate, wider toward apex; sulcus made obsolete before apex by a very feebly elevated, obtuse, narrow apical projection; declivital margins with four small acute teeth, the third a small granule. Elytral pubescence of rather abundant fine,

short, yellow hair. Second ventral abdominal segment as long as third and fourth segments united.

Female - Declivital sulci shallower; marginal teeth smaller than in the male.

Type locality - Rogers Pass, British Columbia.

Distribution - British Columbia, east to Alberta.

Hosts - Abies lasiocarpa, and Larix americana.

This is an abundant species which breeds under the bark of the bole of the host tree. Collected at Amazon Mine June 13, 1946, 7200 ft. from Pinus contorta; Dry Canyon June 16, 1946, 6500 ft., and Beaver Creek July 26, 1946, 8500 ft. from Pseudotsuga taxifolia; Dry Canyon June 29, 1946, 8000 ft., and Franklin Basin July 5, 1946, 7300 ft. from Abies lasiocarpa.

Pityokteines Fuchs

Body cylindrical, moderately slender, frons of female with very long, fine, abundant hair. Antennal funicle five segmented; club thickened basally, obliquely truncate, wider than long. Pronotum asperate in front, punctate behind. Declivity with sulci reaching apical margin, the elevation separating declivity from apical margin not complete, allowing sulci to reach apex near the suture.

Pityokteines minutus (Swaine)

Swaine, J. M. (As Dryocotes) Can. Ent. 44:352, 1912.

Length 1.7 to 2.3 mm., 2.88 times as long as wide; color black to dark brown, pubescent.

Male - Frons coarsely, densely, deeply punctured; a broad, weakly elevated impunctate carina on upper half; pubescence of fine, very long yellow hair. Eyes oval, broadly, shallowly emarginate on inner margin.

Antennal club wider than long, obliquely truncate.

Pronotum 1.2 times as long as wide, widest posteriorly; sides arcuate, weakly narrowed anteriorly, broadly rounded in front; asperities small, numerous; punctures dense, rather coarse, deep, subgranulate on sides, median line narrowly carinate, broadly impunctate and shining; pubescence of abundant long, fine, yellow hair.

Elytra 1.68 times as long as wide, as wide as pronotum; sides straight and subparallel to declivital origin; first striae moderately, others weakly impressed, punctures coarse, very deep, separated by their own diameters; interspaces wider than striae, punctures smaller and almost as numerous as those of striae, granulate at declivital origin. Declivity with sutural striae rather deeply sulcate, first interspace finely granulate, punctures confused, margins with two small acute teeth and two small tooth-like granules on each side; sulci reaching apical margin near suture, the apical projection not completely separating the sulcus from the apex. Elytral pubescence of abundant fine, long, yellow hair.

Female - Frons rather densely covered with very long, fine, yellow hair; declivital teeth reduced to small indistinct granules.

Type locality - Colorado.

Distribution - Colorado, Wyoming, Utah, California, and Oregon.

Hosts - Abies lasiocarpa, and Pseudotsuca taxifolia.

A common species found in the bark of the bole of Abies lasiocarpa. Collected at Amazon Mine June 13, 1946, 7200 ft.; Franklin Basin July 5, 1946, 7300 ft.; Dry Canyon July 13, 1946, 9000 ft.; the Summit of Logan Canyon Aug. 9, 1946, 8000 ft.; and West Hodge Creek May 17, 1947, 8000 ft.

This species was also reported by Thatcher (1935) and by Knowlton and Nye (1939).

Dryocoetes Michhoff

Body cylindrical, moderately slender. Antennal funicle five segmented; club thickened basally, obliquely truncate, with or without sutures on the outer face. Eyes oval, emarginate. Pronotum granulate over the entire surface, anterior margin nearly smooth. Declivity abrupt, and flat.

Key to the Species of Dryocoetes

- A. Sutural striae impressed on disc; interspatial punctures smaller than those of striae; length 2 mm. D. sechelti Swaine
- AA. Sutural striae not strongly impressed on disc; interspatial punctures as large as striae punctures; length greater than 3.5 mm. D. confusus Swaine

Dryocoetes sechelti Swaine

Swaine, J. M. Can. Ent. 47:358, 1915.

Length 1.7 to 2.2 mm., 2.65 times as long as wide; color reddish, conspicuously pubescent.

Frons convex, closely, rather coarsely, granulate-punctate, with a rather weakly elevated, broad, longitudinal carina extending from epistoma to vertex; epistomal fringe of coarse yellow hair of variable density; frontal pubescence of sparse, fine, rather long, yellow hair. Eyes oval, about 2.5 times as long as wide, broadly, weakly emarginate on inner margin. Antennal funicle much shorter than club; pedicel as long as other four segments united, fifth segment as wide as the length of the last four segments combined; club about as long as wide, obliquely truncate.

Pronotum 1.06 times as long as wide, widest on posterior half; sides arcuate, broadly rounded in front, nearly subcircular, strongly convex;

summit behind middle frequently impunctate; finely regularly asperate before summit and on sides to the base, coarsely granulate-punctate behind summit; pubescence of rather long, erect, yellow hair, more abundant on sides and in front.

Elytra 1.7 times as long as wide, slightly wider than pronotum; sides nearly straight and subparallel to declivital origin, very broadly rounded behind; first striae moderately, others feebly impressed, punctures rather small, deep, separated by their own diameters; interspaces slightly wider than striae, punctures smaller and about as numerous as those of striae, each puncture bearing a rather long, erect, yellow hair. Declivity steep, suture elevated; strial punctures reduced in size, deep; second interspace narrowed at apex; declivital pubescence as on disc.

Sexual differences not noticeable.

Type locality - Sechelt, British Columbia.

Distribution - Only the type series is reported in the literature.

Hosts - Previously unknown.

A rare species collected from the bark of the bole of the host tree. Collected at Dry Canyon June 16, 1946, 6500 ft. from Pseudotsuga taxifolia; and Franklin Basin July 24, 1946, 8000 ft. from Abies lasiocarpa (Det. W. H. Anderson).

Dryocoetes confusus Swaine

Swaine, J. M. Can. Ent. 44:351, 1912.

Length 3.4 to 4.2 mm., 2.5 times as long as wide; color reddish to nearly black, clothed with abundant long, erect, yellow hair.

Male - Frons convex, with a rather deep subconical impression medially just above epistomal base; deeply, coarsely, closely punctured,

each puncture bearing a long fine yellow hair; epistomal fringe rather dense. Eye oval, about 2.7 times as long as wide, rather deeply broadly emarginate. Antennal club obliquely truncate.

Pronotum as long as wide, widest just behind middle; sides arcuate, broadly rounded in front, subcircular; entire surface asperate, finer behind middle; pubescence of long erect yellow hair, rather abundant on sides and in front.

Elytra 1.6 times as long as wide, very slightly wider than pronotum; sides nearly straight and subparallel to declivital origin, slightly tapered and broadly rounded behind; first striae distinctly, but weakly, others very feebly impressed, punctures of medium size, distinct, rather shallow, separated by their own diameters; interspaces slightly wider than striae, punctures nearly as close and large as those of striae, becoming granulate toward declivity, punctures confused except on the first and second interspaces; each interspatial puncture bearing a long, erect, light brown hair. Declivity flattened, suture elevated; striae punctures considerably reduced in size, but distinct; inter-spaces uniserially finely granulate, more strongly on the upper half; pubescence as on disc.

Female - Frons very finely granulate, with a dense circular brush of rather short, reddish-yellow hair, longer on margins, rather sparse in the position of the concavity of the male.

Type locality - Colorado.

Distribution - Utah and Colorado, north to British Columbia and Alberta.

Hosts - Abies lasiocarpa, and A. balsamea.

Abundant and very destructive to Abies lasiocarpa in some areas. Collected at Dry Canyon July 13, 1946, 9000 ft.; Franklin Basin July 24, 1946, 8000 ft.; Beaver Creek July 26, 1946, 8000 ft.; and West Hodge Creek May 17, 1947, 8000 ft.

This species was also reported by Thatcher (1935) and Knowlton and Nye (1939).

Anisandrus Ferraris

Sexual dimorphism marked; females moderately stout, cylindrical, with normal wings; males very short, convex, with posterior wings reduced or absent. Antennal funicle five segmented; club thickened basally, obliquely truncate. Eyes oval, deeply emarginate. Pronotum wider than long, coarsely asperate before summit, finely reticulate behind; anterior margin broadly rounded and serrate. Declivity arched, not strongly sulcate.

Anisandrus pyri (Peck)

Peck, W. D. (As Scolytus) Mass. Agr. Reports 4:205, 1817.

Female - Length 2.7 to 3.2 mm., 2.25 times as long as wide; color black.

Frons convex, broadly elevated along median line; finely granulate-punctate at epistomal base, very sparsely, finely punctured above; finely reticulate; pubescence of very sparse, fine, long, black to yellow hair. Eye oval, very deeply emarginate. Antennal club oval-elongate, thickened basally, obliquely truncate.

Pronotum 1.13 times as wide as long, circular, coarsely asperate before summit, serrate on anterior margin, reticulate behind, very sparsely, minutely punctured behind summit; pubescence of fine, short,

sparse, yellow hair.

Elytra 1.2 times as long as wide, as wide as pronotum; sides very feebly arcuate, subparallel to declivital origin, broadly rounded behind; striae feebly impressed, punctures rather small, shallow, separated by their own diameters; interspaces twice as wide as striae, minutely, sparsely, irregularly setose-punctate. Declivity gradual, weakly arched, rather flat; seventh interspace acutely elevated posteriorly. Elytral pubescence of rather sparse, short, fine yellow hair.

Male - Length 2 mm., 1.03 times as long as wide; strongly convex.

Head as in female. Pronotum 1.06 times as wide as long, more narrowly rounded in front, less strongly convex, asperities rather sparse; pubescence longer, more numerous.

Elytra strongly convex from base, otherwise similar to female; posterior wings absent. Elytral pubescence very long on sides.

Type locality - Massachusetts.

Distribution - Southern Canada, northeastern United States and the Pacific Coast.

Hosts - Numerous broadleaf trees, including orchard fruit trees.

A rare wood-boring ambrosia beetle in Logan Canyon, which was collected at Card Canyon July 17, 1946, 6500 ft. from Populus angustifolia; and at the mouth of Spring Hollow July 26, 1946, 5000 ft. from Betula fontinalis.

Xyleborus Eichhoff

Body rather slender, cylindrical. Antennal funicle five segmented; club thickened basally, obliquely truncate distally, with one or two sutures. Eyes oval, emarginate. Pronotum longer than wide, sides parallel or very slightly narrowed anteriorly; apical margin broadly round-

ed, devoid of serrations. Declivity flattened or weakly sulcate.

Key to the Species of Xyleborus

- A. Striae feebly impressed; scutellum somewhat depressed; a large tooth on each of declivital apices X. arbuti Hopkins
- AA. Striae strongly impressed; scutellum not at all depressed; without a large tooth near declivital apex X. near scopulorum Hopkins

Xyleborus arbuti Hopkins

Hopkins, A. D. U.S.D.A., Office of Sec., Rep. 99:64, 1915.

Length 2.3 mm., about three times as long as wide; color reddish-brown to black.

Frons convex, reticulate, feebly longitudinally carinate; punctures large, shallow, rather sparse; pubescence of long yellow hair, a rather sparse epistomal fringe.

Pronotum 1.22 times as long as wide, widest in front of middle; sides nearly straight, very feebly narrowed posteriorly, broadly rounded in front; closely, finely asperate on anterior third, anterior margin not serrate; very finely reticulate behind; very minutely, sparsely punctured; pubescence fine, short and sparse.

Elytra 1.8 times as long as wide, moderately shining, as wide as pronotum; sides feebly arcuate, nearly subparallel on anterior two-thirds, tapered, then very broadly rounded behind; striae feebly impressed, punctures small, very shallow, separated by about twice their own diameters; interspaces rather wide, punctures smaller and nearly as numerous as those of striae. Declivity with first and third interspaces weakly elevated and serrate at least on upper half; second interspace narrowed apically; seventh interspace weakly elevated and serrate to apex, the

last serration rather large and near the suture; other interspaces usually with a few minute granules. Elytral pubescence of rather abundant fine, long, yellow hair.

Sexual differences not pronounced.

Type locality - Walker, California.

Distribution - California.

Hosts - Arbutus menziesii.

An uncommon wood-boring ambrosia beetle found in the bole of Populus angustifolia. Collected at the mouth of Logan Canyon June 9, 1946, 4800 ft.

Xyleborus near scopulorum Hopkins

A species, apparently undescribed, belonging to the genus Xyleborus was collected during this study. A description of this species will not be included here, but will be published at a later date.

DISCUSSION

The preceding keys and descriptions have been presented here to enable students and foresters to more easily identify the species of Scolytidae occurring in the Logan Canyon area. The rediscovery and redescribing of many rare species, as well as the data obtained concerning the geographical and host distributional knowledge, will be of value to taxonomists. A list of the described species presented in this paper, not previously recorded in the literature as occurring in Logan Canyon follows.

✓ Scolytus praecox

Trypophloeus punctipennis

✓ Scolytus niceae

Trypophloeus populi

Phloeotribus puberulus

Xyleborus pinus

Dendroctonus valens

Pityophthorus inquietus

<u>Phloeosinus hoferi</u>	<u>Pityophthorus demissus</u>
<u>Phloeosinus neomexicanus</u>	<u>Pityophthorus opimus</u>
<u>Scierus annectens</u>	<u>Pityophthorus bassetti</u>
<u>Pseudohylesinus nebulosus</u>	<u>Pityophthorus virilis</u>
<u>Hylurgops ruginennis</u>	<u>Pityogenes fossifrons</u>
<u>Hylurgops porosus</u>	<u>Ins guildi</u>
<u>Trypodendron retusum</u>	<u>Orthotomicus lasiocarpi</u>
<u>Trypodendron lineatum</u>	<u>Dryocoetes sechelti</u>
<u>Trypodendron rufitarsus</u>	<u>Anisandrus pyri</u>
<u>Procrichalus populi</u>	<u>Xyleborus arbuti</u>

Host plant relationships previously unrecorded in the literature are as follows.

Phloeotribus puberulus from Abies lasiocarpa, and Picea engelmanni.

Pityophthorus inquietus from Pinus monophylla, and P. flexilis.

Pityogenes fossifrons from Pinus flexilis.

Orthotomicus lasiocarpi from Pseudotsuga taxifolia, and Pinus contorta.

Anisandrus pyri from Populus angustifolia, and Betula fontinalis.

Xyleborus arbuti from Populus angustifolia.

Rare species collected during this investigation, for which the host plant previously was unknown are as follows.

Crychalus ruficollis from Abies lasiocarpa.

Trypophloeus punctipennis from Salix scouleriana.

Dryocoetes sechelti from Abies lasiocarpa, and Pseudotsuga taxifolia.

Errors in identifications which have appeared in the literature, pointed out by this paper are: (1) the genus Xylocomesus Thatcher is a synonym of Rhyacelus Germar and the species are transferred from the

family Scolytidae to Curculionidae, (2) specimens of Scolytus monticolae were incorrectly reported as S. wickhami, (3) Scolytus piceae was previously reported from incorrectly identified specimens of an undetermined species of Scolytus collected in Abies lasiocarpa, (4) specimens of Phloeosinus neomexicanus have previously been incorrectly reported as P. juniperi and as P. utahensis, and (5) specimens previously reported as Pityophthorus exilis are P. gracilis.

Ips chamberlini Swaine was reported by Thatcher (1935) from specimens collected in Pinus contorta in Logan Canyon. The host tree which was reported is widely separated from the Pseudotsuga taxifolia from which the type series was collected, and the distance from the type locality is great for such a rare species. Although several hundred specimens of the closely related I. radiatae were collected in the area where the I. chamberlini were taken, no abnormal specimens were collected which might have been I. chamberlini. Until specimens of this species can be examined it will not be included in this work; the specimens in question may represent an undescribed species.

In addition to the described species, six apparently undescribed species of Scolytidae were collected in Logan Canyon. Three of the species belong to the genus Carphoborus and will be described in a revisional study of that genus for which material is now being gathered. The remaining species, a species of Ips, one of Pityogenes, and one of Xyleborus, will be described as soon as sufficient material for description can be collected.

Most of the species of Scolytidae which occur in Logan Canyon are not considered as destructive species to timber and other plants which protect the watershed area. These species are a factor in producing a better quality of timber by causing more rapid death and decay of the

lower shaded out branches, and of suppressed and dying trees, allowing the healthier individuals to increase their rate of growth and improve the quality of lumber produced. A few species are considered as being destructive because of their habit of aggressively attacking and killing healthy trees. Dendroctonus monticolae attacks all species of pine, and is abundant in Logan Canyon. Although large numbers of trees are killed annually by this species, the lumber produced by pine in Logan Canyon is not considered to be of sufficient value, and the damage is not great enough to warrant control operations. Dryocoetes confusus is very destructive to Abies lasiocarpa locally in some areas. On a ten-acre area at the upper limits of Dry Canyon, this species killed between ten and thirty percent of the Alpine fir. The fir is not of sufficient value, and the damage is not extensive enough to warrant control operations at this time.

Other species which become abundant in slash, and are a menace to cut timber are Ips oregoni, Pityogenes knechteli, and Pityophthorus tuberculatus in Pinus contorta. Dendroctonus pseudotsugae may attack cut logs of Pseudotsuga taxifolia, but usually does not enter healthy standing trees. These species are best controlled by burning or otherwise disposing of slash after cutting operations.

Hylurgops rugipennis has formerly been recognized only as a secondary enemy of pine, usually breeding in the roots of a tree which had been attacked and killed by Dendroctonus beetles. Preliminary observations made during the last few days of this investigation have led the writer to believe that in many instances in Logan Canyon H. rugipennis attacks and kills one or more of the large roots of a particular tree

before the Dendroctonus attack on that tree begins. On more than fifteen occasions D. monticolae was observed to be attacking an apparently healthy tree; examination of the roots, however, revealed the work of H. rufipennis to be in one or more of the large roots of each tree. In all cases observed H. rufipennis had completed development and emerged from one or more of the roots before the eggs of D. monticolae had hatched. In two instances H. rufipennis of the emerging brood was observed to be attacking other roots of the same tree in which they had developed at the time D. monticolae began its attack.

At the present time the commercial value of the timber in the Logan Canyon area is not great enough, and the species of Scolytidae are not causing sufficient damage to warrant the cost of the expensive control operations. Control measures must be applied over large areas at least twenty miles in diameter if they are to be effective. They consist of locating all trees within the area which are infested with the young larvae of the destructive species, and then destroying them. Destruction of the brood may be accomplished by logging the infested trees and removing them ten miles or more from the nearest trees which could become infested, by the removal of the bark, or by burning the infested trees. The particular method used depends upon the species of beetle causing the damage, and the current expense of applying a particular method of control.

Although a considerable amount of time was spent in making collections, and several thousands of specimens were collected and examined during this study, the list of species of Scolytidae occurring in Logan Canyon is by no means complete. On several occasions a single specimen of a particular species was collected, but because it is necessary to

have both sexes for the determination of species, it has been impossible to recognize such specimens. At other times engravings of several species have been observed which differed from the species collected, but no specimens remained in them for collection. These species are apparently very rare and are not likely to be encountered by the average collector, nor have they any great economic importance at this time.

SUMMARY

The purpose of this investigation has been to clarify and revise existing keys and to describe briefly the species of Scolytidae occurring in the Logan Canyon area of Utah. Logan Canyon presents a wide range of biological life zones and a great variety of Scolytid host plants.

The beetles were collected from as many host plants as possible, and at several locations and elevations if the range of the host plant would permit. As large a series of beetles as possible were collected in each sample and preserved in a vial of 70-percent alcohol. From this series, representative specimens were mounted and labeled. When only larval specimens were available rearing of adults became necessary. Records were made at the site of the collection giving information regarding the locality, hosts, and other data which was of assistance in identifying the species collected.

Keys to all of the species of Scolytidae occurring in the Logan Canyon area are presented in this work, and they are also described here except those belonging to the genera Scolytus and Pityophthorus and those species which apparently are new to science. The results of this study show 57 species, representing 24 genera, and 3 subfamilies

of the family Scolytidae to be present in the Logan Canyon area.

Of the 57 species presented in this work, 28 described species have not previously been reported in the literature as occurring in the Logan Canyon area. In addition to the 28 described species, six apparently undescribed species were collected, three of which belong to the genus Carpoborus, one to the genus Ips, one to the genus Pityogenes, and one to the genus Xyleborus. Unreported host relationships of six species of beetles were found, and also the hosts of three rare species were discovered for which the host previously was unknown.

Although some of the species of Scolytidae are causing damage to the timber crop in Logan Canyon, it is not extensive or severe enough to warrant control measures at this time. Preliminary observations of the writer indicate that Hylurgops ruginervis is a primary enemy of pine in Logan Canyon attacking and weakening many of the trees which later are attacked by Dendroctonus monticolae.

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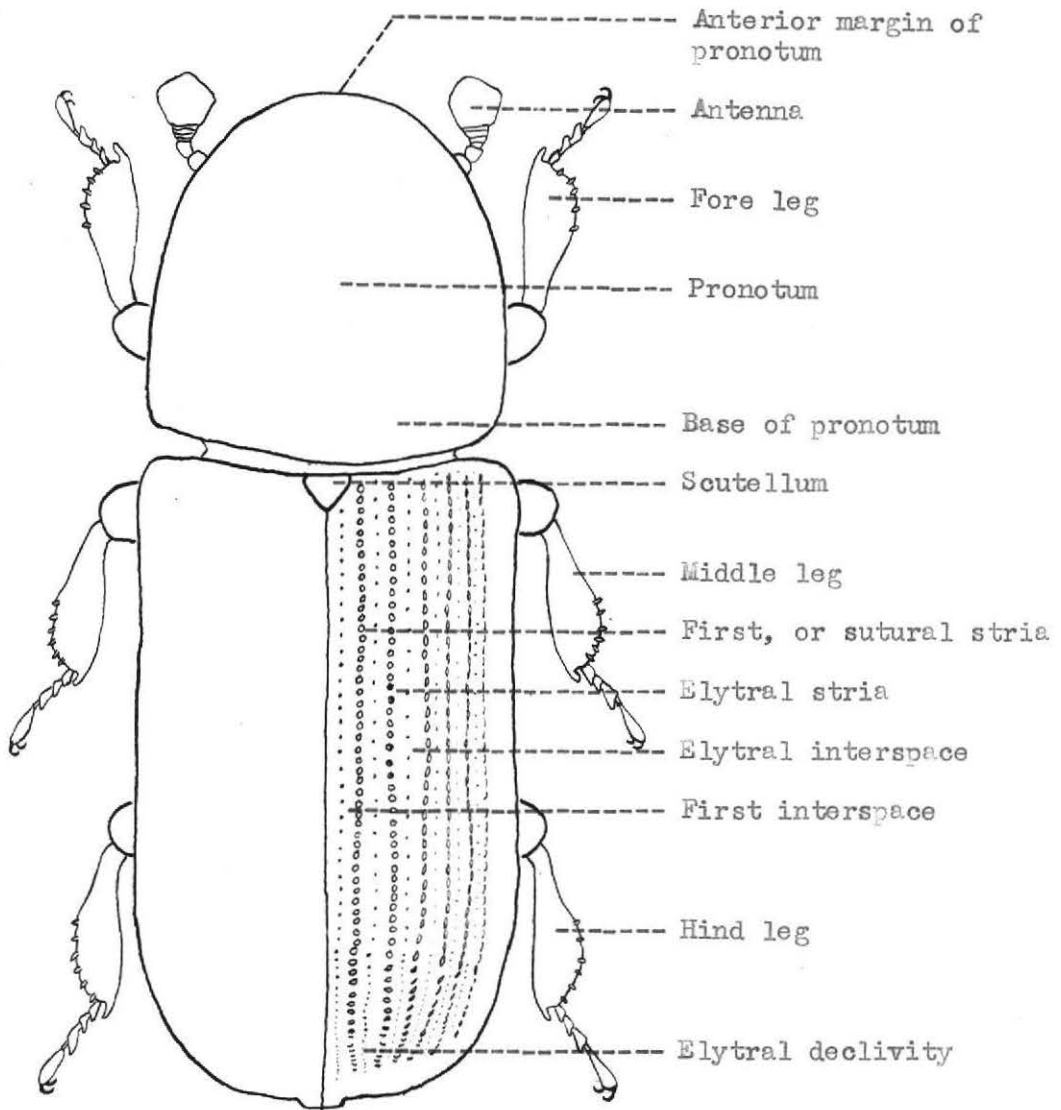
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PLATE I



Dorsal aspect of *Dryocoetes sechelti*