The Bark Beetles of Minnesota
(*Coleoptera: Scolytidae*)

Harold Rodney Dodge
Division of Entomology and Economic Zoology

University of Minnesota
Agricultural Experiment Station

(Accepted for publication April 1938)

CONTENTS

The Bark Beetles of Minnesota
(Coleoptera: Scolytidae)

Harold Rodney Dodge

Since the beginning of this century our knowledge of the Scolytidae has increased greatly. In Swaine's catalog (1909) 191 species are recognized from America north of Mexico. In Leng's catalog (1920) 383 species are listed, and at present there are about 550 described species from the same territory. This great increase in our knowledge of the family is due nearly entirely to the writings of A. D. Hopkins, J. M. Swaine, and M. W. Blackman. To date, 64 species have been taken in Minnesota, and a number of others doubtless occur. The material upon which this bulletin is based is from the University of Minnesota insect collection, and specimens collected by the writer during the summer of 1936. Much of the former material had been collected by S. A. Graham at Itasca Park.

The scolytids are usually poorly represented in insect collections. This is due, not to scarcity of these beetles, but rather to their habits and often minute size. Practically the entire life of the beetle is spent in the seclusion of the bark or wood of its host tree, and specimens are seldom taken by the ordinary collecting methods such as sweeping, beating, examining beach drift, or at electric lights. Even the collector who examines the bark of logs and stumps is apt to be rewarded only by beetles of other families until he learns to recognize the time at which such is inhabited by bark beetles. Species known to breed in the same material for two successive years are rare. Usually a tree or tree part is infested only during the season of its death, and often it is deserted by the beetles before the end of the season, so any subsequent investigation will yield only their galleries and perhaps a few dead specimens of the beetles.

A good hand ax and a pocket knife are indispensable for collecting scolytids, and a pair of forceps or an aspirator is a great aid in handling the specimens.

ECONOMIC IMPORTANCE

The bark beetles are considered the most important insect enemies of our forests. Species of the genus *Dendroctonus* are of greatest importance, several species often taking heavy toll in the coniferous forests of our western states. The outbreaks are often accompanied by fires. In the

ACKNOWLEDGMENTS: The writer wishes to express his appreciation to Dr. C. E. Mickel for suggesting this subject and for his helpful criticisms and suggestions; to Dr. M. W. Blackman for determination of specimens of *Pityophthorus* and reviewing the determinations of *Micracis* and *Scolytus,* and to Dr. J. M. Swaine for correspondence regarding several of the species.

pine forests of the South and the spruce forests of the East, *Dendroctonus frontalis* and *D. piceaperda,* respectively, have occasioned serious losses. *Dendroctonus valens* often attacks the bases of healthy pines, causing dead areas in the bark which are mistaken for fire scars. Hopkins (1909b) estimates that the trees killed by *Dendroctonus* during the previous 50 years would have had a stumpage value of over $1,000,000,000 at the time of his writing.

Blackman (1922) classified the damage done by Scolytidae into five groups, thus:

1. Injuries to Forest Reproduction. Most of the injury of this nature is due to other kinds of insects, but species of *Conophthorus* destroy seeds of various pines, and bark beetles may kill young trees, especially if weakened by transplanting.

2. Affecting the General Growth and Health of Trees. Some bark beetles and ambrosia beetles are able to breed in living trees, thus seriously weakening the host without actually causing its death.

3. Killing Trees. The greatest damage is done by beetles killing trees outright. Some species seem to prefer breeding in living trees; others attack them only when the beetle is in great abundance and preferred breeding material is lacking.

4. Injury to Timber during the Process of Lumbering. Many species prefer to breed in recently felled timber. The true bark beetles do not destroy the wood directly, but may introduce fungi which lessen the value of the wood if it is not quickly utilized. The relationship of species of the genus *Ips* with the Blue Stain fungus is revealed by Leach, Orr, and Christensen (1935). The galleries of ambrosia beetles penetrate the wood, causing dark stains and holes in the lumber.

5. Injury to Utilized Timber. Damage of this nature is negligible if the timber is barked. Damage by bark beetles to seasoned timber is exceptional, and none of the species that occur in this state are known to breed in seasoned timber. The usual insects responsible for such damages belong to the families Lyctidae, Bostrychidae, and Anobiidae.

Swaine (1918) groups the bark beetles according to the damage they do into primary enemies, secondary enemies, and neutral species. Primary enemies are insects that commonly attack and kill healthy trees. Some species normally secondary may, under favorable conditions, develop a population great enough to be able to attack and kill healthy trees and thus become primary. Most secondary species confine their attacks to recently felled timber, dying trees, or trees weakened by fire. Some species hasten the death of suppressed branches and thus may actually be considered beneficial because they help to produce a better grade of log. Neutral species are insects known to breed only in dying or dead bark and not known to cause any injury to living trees.

The injuries to standing timber are classified by Swaine (1918) into three groups:

1. The Normal Annual Loss. Everywhere throughout the forest,

injured, unthrifty, and overmature trees are attacked and killed by various species of bark beetles and wood borers. Probably the greatest damage done by bark beetles in this state falls under this heading.

2. Sporadic Outbreaks. Small local outbreaks, usually in the neighborhood of slash from cuttings, windfalls, or fire-killed timber. The beetles involved are usually secondary species.

3. Epidemic Outbreaks. Outbreaks developing rapidly over a large area, involving the death of many hundreds or thousands of trees. Such outbreaks fortunately do not occur in this state. *Dendroctonus piceaperda* and *Scolytus quadrispinosus* are species capable of producing such outbreaks, but both appear to be very rare in this state, and the host tree of the latter as well. *Pityokteines sparsus* is a common primary enemy of balsam fir, but the host tree is usually well dispersed in the forests, and thus conditions are not favorable for outbreaks of epidemic proportions. *Dendroctonus simplex* is a common primary enemy of tamarack, but it is not known to become epidemic.

CONTROL MEASURES

Hopkins (1909b), Swaine (1918), and Blackman (1922) give good control recommendations. In general, control measures against bark beetles are hardly necessary in this state, and there is no record that they have been employed. The most important measure would be prompt utilization of fire-killed timber, winterfall, and logged timber, and disposal of slash. In regions where logging operations are carried on from year to year, an enormous scolytid population may be developed in the slash without destruction of living timber, but when cutting is discontinued the beetles will be forced to attack the standing timber.

More important than burning the tops is barking the stumps and other thick-barked pieces, as well as peeling or floating the logs if they are not to be immediately utilized. Barking is done to prevent breeding, or, if broods are present, to kill them before they have reached maturity. This process should therefore not be delayed too long after cutting. Barking will not kill the parent adults nor the brood if it is fully matured, but all stages from the egg to young adults are quickly killed unless the bark is thick and does not dry properly. Floating the logs is a more certain method of killing not only the brood, but the parent beetles. Where it can be employed, it is a less costly method and is preferred.

To destroy infestations in standing timber, quick action may be required. The brood is usually well established before the foliage gives evidence of dying, and in species of *Ips,* at least, the brood leaves the infested trees before the end of the season. In the case of those beetles whose brood overwinters in the infested tree, the trees may be cut during the winter and floated before emergence of the beetles in the spring. In thin-barked trees, destruction of the brood may be effected by felling and exposing the logs to the summer sun, turning them occasionally to be certain that all sides have been exposed. The writer noted a very high mortality of *Dendroctonus simplex* brood in the upper side of a tamarack log less than two days after it was felled in late June. The brood at this time consisted of larvae, pupae, and recently transformed adults.

No species of bark beetle appears to be of any consequence in our orchards. The usual control measures for such insects consist of burning infested trees and prunings, whitewashing or wrapping the trunks with burlap, and increasing the vigor of the trees by fertilization and cultural methods.

NATURAL CONTROL

A degree of natural control is effected by climatic conditions and by parasitic and predatory enemies. Instances of climatic control include checking of an epidemic of *Scolytus quadrispinosus* in the East by an abnormally wet season (1915), and destruction of *Dendroctonus frontalis* in the northern part of its range by an abnormally cold winter.

Among the insect enemies of scolytids are a number of species of small wasp-like insects that parasitize the immature stages. Blackman (1922) records over 90 per cent parasitism of *Leperisinus aculeatus* in one instance. Predatory beetles found in scolytid galleries include Cleridae, certain Histeridae, and the tenebrionid, *Hypophloeus*. Of these the clerids, commonly called checkered beetles, are the most common and of greatest importance. There is some doubt that *Hypophloeus* are actually predaceous, and they may prove to be entirely fungivorous or scavengers.

Woodpeckers sometimes feed extensively on broods of bark beetles, and the bark of infested trees may be nearly stripped by their activities. Other birds may feed to a lesser extent upon bark beetles. Among the few records of birds other than woodpeckers feeding on scolytids, the chimney swift and swallows are most noteworthy.

LIFE HISTORY AND HABITS

The scolytids, like other beetles, have four stages in their development, namely, egg, larva, pupa, and adult. Among the beetles, the scolytids are unusual in the method of providing for their young. The adults of all species construct a more or less elaborate system of galleries in the bark or wood of their host plant and deposit their eggs usually singly in niches along the sides of the burrows, each egg being packed tightly in place with boring dust. Species like *Dendroctonus valens* and *Orthotomicus caelatus* deposit their eggs not singly, but in groups along the sides of the egg galleries, and in *Anisandrus* and *Xyleborus* the eggs are laid free in the galleries. Galleries will be discussed in more detail further on.

The egg is pearly white, oblong, oval or nearly globular in shape, with no sculpturing or other distinguishing characteristics. It varies greatly in size in proportion to the size of the adult beetle. The egg of *Carphoborus* is said to be nearly the size of the abdominal cavity of the female, but the eggs of most scolytids are much smaller than this. The duration of the egg stage is rather short, varying with the species of beetle and temperature conditions. Blackman (1915) found the average incubation period of *Pityogenes hopkinsi* to be seven days, and this figure may be taken as indicative of the usual duration of the egg stage.

The larva is a legless, white, fleshy grub with a harder, light-brown head capsule. The body is bent more or less strongly in an arc. The larva of *Trypophloeus nitidus* and those ambrosia beetles whose larvae occur free in the tunnels, namely *Anisandrus* and *Xyleborus,* are more elongate and less curved. It has been shown (Blackman, 1915) that *Pityogenes hopkinsi* has normally five larval instars or stadia. This means that there are five molts, the larva becoming larger after each successive molt. At the time of the last molt the larva transforms to the pupa.

No morphological characters of the larvae have been discovered which will distinguish them from curculionid larvae. That the larvae do possess distinguishing features is indicated by Hopkin's (1908a) study of the larvae of *Dendroctonus.*

The length of the larval stage under favorable conditions is less than a month, but periods of adverse weather may prolong this considerably. The larval period of *Pityogenes hopkinsi* was found by Blackman (1915) to average 20 days. In some species the late broods may overwinter in the larval stage, and in such cases the length of the larval period is the better part of a year. Watson (1931) found the length of the larval period of *Dendroctonus rufipennis* to be fully a year in northern Ontario, the species requiring two years in that locality to complete its life cycle.

The pupal period is an intermediate or "resting" stage between the larva and the adult. Though quiescent in appearance, great changes are taking place within the body. The pupa is whitish in color, becoming slightly darker upon maturity, and assumes but partly the characters of the adult. The antennae, legs, and wings are present but are incapable of movement, the only motion made by a pupa being a rather vigorous wriggling of its abdomen when disturbed. The wings are shorter than those of the adult insect and are directed backward and downward, their tips being on the ventral side of the body.

Pupation takes place in the true bark beetles at the end of the larval tunnel and may be in the inner bark, at the cambium layer, or in the wood. Larvae of *Orthotomicus,* at least in the Minnesota species, penetrate the sapwood to pupate, and often under crowded conditions *Pityophthorus* larvae will penetrate the twig and pupate in the wood or pith. Pupation among ambrosia beetles occurs in the larval cradles or in the parent galleries. The duration of the pupal period is short under favorable conditions. Blackman (1915) found it to vary from 5 to 10 days for *Pityogenes hopkinsi,* the average being 6 days. The average for *Hylurgops pinifex* is 7 days. Occasionally some of the late brood of certain species will overwinter as pupae, but pupae and callow adults of many species do not survive the winter. The pupal cell is usually merely a slight to moderate enlargement of the terminal end of the larval tunnel, but in the case of *Hylurgops pinifex* the pupal chamber is lined with a hardened substance composed of frass and excrement (Blackman, 1918).

The adult just after transformation is soft and of light color, and it is a matter of days or even weeks before its body has hardened and attained the usual dark color. Upon maturity the adults leave their brood tree in search of another host to breed in, either at once, or at the beginning of the following season. Some species feed for a time on twigs and petioles of healthy trees before constructing their brood burrows. Others, before their emergence, feed quite extensively under the bark of the material in which they were reared.

In Canada, Simpson (1929) has shown that *Polygraphus rufipennis* adults may live for portions of three seasons. That is to say, beetles that transform to the adult in one season will overwinter and breed the next season, and some individuals will successfully pass a second winter and construct brood tunnels the following spring. During the course of a season the adults may construct three sets of brood galleries. This feature of several broods being produced by a single generation of beetles is not peculiar to *Polygraphus.* It occurs in *Dendroctonus* and *Ips,* and subsequent investigation may prove it to be a common phenomenon throughout the family. Severin (Hopkins, 1909b) showed that the European *Dendroctonus micans* constructs a number of galleries and may hibernate for two winters, the female laying 150 to 200 eggs during her lifetime. The number of galleries constructed during a generation must be considered in figuring the reproductive potential of a species. Blackman (1918) showed that 50 engravings of *Polygraphus rufipennis* averaged 20.8 egg niches per female, the maximum number being 53. To arrive at the number of eggs produced by a female, the average number of eggs per gallery must be multiplied by the number of broods produced.

Because of the numerous broods produced during a season by some species, there is considerable difficulty in interpreting the life history, and many records of generations per year are based upon incomplete or wrongly interpreted data. Few thorough seasonal studies have been made on any species, that of Simpson on *Polygraphus rufipennis* being the most revealing study of this nature. It was shown that this species has but one generation per season, for the adults of the first brood in the spring do not emerge until the following spring. If these beetles were to emerge and reproduce the same season, there would be two generations per season; if the brood of the second generation were not to mature until the following spring, it would be called a partial second generation.

Certain species have but one brood per season. This is true in the case of *Anisandrus obesus,* the female being found in the tunnel with her progeny throughout the season. This may be the case with other ambrosia beetles as well, for in these insects the duties of the parent beetles are not terminated with the completion of egg laying. Hubbard (1897) shows that the adults are necessary to prevent the establishment of other fungi in the burrows and keep the culture of ambrosia fungi pure. *Trypodendron betulae* may extend its entrance burrow to a greater depth after the first brood galleries are completed and construct a second set of galleries, thus producing two broods in a common set of galleries. Gossard found that in Ohio *Scolytus rugulosus* has two generations per year, each generation producing a single brood. Blackman's observations on *Leperisinus aculeatus* in Mississippi indicate that each generation produced only one brood, for he observed that the overwintering adults had by April 24 completed their burrows and about half of them were dead in their galleries. Nearly all of the parent beetles were dead on May 8.

Watson (1931) showed that in the climate of northern Ontario *Dendroctonus rufipennis* requires two years to complete its life cycle. The first winter is passed as one-third-grown larvae and the second as young adults. Parent beetles were not observed to cut more than one set of tunnels and in most cases died in the egg galleries before winter.

Mating takes place in the nuptial chamber or at the entrance to the newly started burrow in most species, but in genera like *Anisandrus* and *Xyleborus,* in which the males are flightless, mating takes place, if at all, in or upon the brood tree before the females take their flight. The males are so puny and so rare, many galleries having none at all, that it does not appear likely that fertilization is necessary for reproduction.

Blackman (1915, 1918) concludes from observations of his own and of others that the females of monogamous species construct the entrance gallery and nuptial chamber, whereas in polygamous species this is the duty of the males. In *Pityogenes hopkinsi,* a polygamous species, the males are demonstrated to leave their hibernating quarters several days earlier than the females, so that when the females appear the males have already started the construction of the galleries. Mating in this species was observed in one instance, the body of the female being in her newly started egg gallery and the male being in the nuptial chamber.

In the monogamous *Chramesus hicoriae* the females of the brood are demonstrated (Blackman & Stage, 1924) to emerge one to three days before the males, exactly opposite the case of *Pityogenes hopkinsi.* Monogamous species have been observed to mate at the entrance to the burrow, the female lying in the burrow with the posterior part of the body exposed (Gossard, 1913, and Blackman and Stage, 1924).

The female of those species whose brood tunnels are characterized by egg niches constructs each niche at the far end and to one side of the egg gallery, then extends the burrow slightly before constructing another niche. It is necessary, therefore, for her to reverse her position in the burrow to deposit each egg, so that after the construction of each egg niche she backs up to a turning niche or the nuptial chamber, reverses her position, backs into the gallery and deposits an egg in the niche, then reverses her position again in a similar manner and packs the egg tightly in place with boring dust. In the ambrosia beetles the gallery may be extended quite deeply before any egg niches are formed, and the egg niches have not been observed less than a beetle's length from the blind end of a tunnel. The beetles would not therefore have to reverse their position to deposit an egg in an egg niche, and it seems apparent that they do not do so, though a careful study of this has not been made.

In hibernation habits the scolytids vary considerably. A number of species hibernate in the material in which they were reared. Such insects include *Polygraphus rufipennis, Dendroctonus simplex, Pityokteines sparsus, Pityogenes hopkinsi, Pityophthorus,* and others. Some of these species may hibernate as larvae or pupae, but they usually hibernate as adults. *Leperisinus aculeatus, Hylurgopinus rufipes,* and certain others construct hibernation burrows in the bark of healthy trees. In the spring they desert these burrows to search for dead material suitable for breeding purposes. Except for this peculiar habit of hibernation, *Leperisinus aculeatus* is not known to attack living trees. Orr (1935) has shown that certain Minnesota species of *Ips* leave their burrows in the fall to hibernate in the litter at the base of the tree. A similar habit is probably shared by a number of other species. That this is so in the case of *Anisandrus obesus* and *Trypodendron retusum* is strongly indicated by observations at Clintonville, Wisconsin. An aspen tree heavily infested with these ambrosia beetles, especially *A. obesus,* in the fall of 1936 was re-examined on March 19 the following spring, at which time not a single living specimen of either species could be found.

GALLERIES

The various structures of which a complete gallery may be composed are many, and a description of each is not out of place. They will be described in the order in which they are constructed by the beetles. The entrance tunnel is constructed from the surface of the bark (except in the genus *Crypturgus,* which gains access to the inner bark by entering the burrow of a larger species) and communicates interiorly usually with the nuptial chamber. This latter is a more or less enlarged chamber of variable proportions, and it is here that the male is stationed and mating commonly takes place. From it the egg galleries extend in a manner characteristic to the species of beetle. In some species, notably the ambrosia beetles, the nuptial chamber is lacking, and the entrance tunnel leads directly to the egg galleries.

In *Anisandrus* and *Xyleborus* the egg galleries remain the ultimate step in the burrowing, for the eggs are laid free in the galleries, and the brood matures and emerges by way of the entrance gallery without in the least extending the burrows made by the parent. In the other ambrosia beetles the females construct egg niches along the sides of the galleries above and below, and during the larval period each member of the brood enlarges its niche to form what is called a larval cradle, a short gallery extending with the grain of the wood. Each larva remains within its cradle and there completes its metamorphosis, the cradle being just large enough to receive the transformed adult. In the other scolytids the larvae tunnel away from the egg galleries and form larval mines, but first more may be said about the egg galleries.

The eggs are most commonly deposited singly in niches at intervals along the sides of the egg galleries. Certain species, however, like *Dendroctonus simplex* and *Orthotomicus caelatus* deposit their eggs in small groups, from several to half a dozen or more, in larger recesses which are termed egg pockets. *Dendroctonus valens* deposits its eggs in layers at irregular intervals along the egg galleries, the enlargement for reception of the eggs being termed an egg groove. Another feature of the egg gallery which may be found particularly in the longer galleries of such insects as *Dendroctonus* and *Ips* are turning niches or ventilation chambers. These are short tunnels constructed at intervals and directed usually toward, though not attaining, the surface of the bark. Their function is to permit the beetle to reverse its position in the gallery without returning to the nuptial chamber, and those directed toward the surface of the bark are thought to increase the ventilation in the burrows. Larval mines are a feature common to the engravings of those species other than ambrosia beetles. In many species they are very regular in direction and seldom intersect each other, but under crowded conditions they often lose their identity. Larvae of such species as *Dendroctonus valens* and *Trypophloeus nitidus* do not construct individual mines, but work together in constructing a large common excavation. The larval mine is terminated by the pupal cell, which is usually somewhat enlarged, and from the pupal cell the transformed adult constructs its emergence tunnel, either directly or after feeding for a time under the bark. The features visible from the surface of the bark are the entrance and emergence holes.

Classification of the Brood Galleries or Brood Burrows (from Blackman, 1922)

1. The Cave-type Burrow. This consists of an entrance gallery, which in the simplest form leads directly into an irregular cavity made by the parent beetles. In this case the eggs are laid either in irregular masses at any part of the cave or in egg niches or grooves at its periphery.

2. The Irregular Elongate Burrows. The gallery in this type is continued for a variable distance and then irregularly widened to produce a place for the reception of the eggs. Example: *Dendroctonus valens*.

3. Simple Longitudinal or Transverse Burrows. These differ from the foregoing in that they are of the same diameter throughout their length. They may be long or short, longitudinal or transverse, and with or without a turning niche or nuptial chamber at the juncture of the

entrance gallery. This type of gallery is illustrated by *Phloeosinus canadensis* and many species of *Dendroctonus* and *Scolytus* (longitudinal type).

4. Forked Longitudinal or Transverse Type of Burrow. These differ from the preceding burrows in that instead of one gallery there are two arising from the entrance tunnel and extending in opposite directions or nearly so. The longitudinal type is illustrated by *Scolytus piceae;* the transverse type by *Pseudopityophthorus minutissimus* and species of *Pthorophloeus* and *Leperisinus.*

5. Double Forked Transverse Burrows. A rare type of burrow similar to a pair of forked transverse burrows joined by a short longitudinal gallery connecting with the entrance tunnel at its middle.

6. Radiate or Star-shaped Burrow. In this type the entrance gallery leads directly into the nuptial chamber from which the egg galleries radiate. The egg galleries may be arranged symmetrically, without regard for the grain of the wood, or they may become chiefly longitudinal or transverse. Radiate burrows are constructed by *Polygraphus rufipennis, Ips, Dryocoetes, Pityogenes, Pityokteines,* and certain *Pityophthorus.*

7. Pith Burrows. Certain bark beetles construct their egg galleries in the pith instead of at the juncture of the bark and wood. Such species are *Micracis opacicollis, Pityophthorus pulicarius, P. puberulus,* and species of *Myeloborus.*

8. Wood Burrows. The egg galleries of this type are excavated in the sapwood. *Micracis swainei* constructs this type of burrow.

9. Simple Unbranched Ambrosial Burrows. The ambrosia beetle tunnels differ from those previously discussed in that the tunnels are produced in the wood and their walls are stained black by a fungus called ambrosia, from which the beetles and their brood derive their nourishment. This type of tunnel is unbranched and is produced directly into the wood, where it is usually enlarged by the larvae into a wide, flat chamber. *Xyleborus saxesceni* produces this type of burrow, but it is not known from Minnesota.

10. Branched Ambrosial Burrows. In this type the entrance tunnel is divided into several to many branches extending in a general plane at right angles to the grain of the wood. Species of *Xyleborus* and *Anisandrus* contruct this type of gallery.

11. Compound Ambrosial Burrows. This type is similar to the last with the exception that the eggs are laid in niches along the upper and lower sides of the galleries and the larvae upon hatching remain in these niches and enlarge them to form short, characteristic larval cradles, such as are found in *Trypodendron, Xyloterinus, Monarthrum, Gnathotrichus,* and *Corthylus.*

Beside the brood galleries the adults may construct feeding and hibernating burrows. Hibernation burrows are constructed by such species as *Leperisinus aculeatus* and *Phthorophloeus liminaris* in the bark of healthy trees. In these short burrows the adults pass the winter and no doubt also derive some nourishment. Feeding burrows are constructed in the twigs and petioles of healthy trees by such species as *Scolytus quadrispinosus* and *Phthorophloeus liminaris*. In some species, as *Pityogenes hopkinsi,* the recently transformed adults feed rather extensively under the bark of the brood tree before their emergence. Hopkins (1915b) reserves the term "brood burrow" for this type of feeding burrow. Hopkins also introduces the term "trial burrow" to designate burrows in the bark of living trees preliminary to the general attack and the excavation of successful egg galleries, and "abandoned or failure gallery" for a gallery which the beetles have been forced to abandon, or killed by the flow of sap or resin.

The brood galleries of the bark beetles are the most conspicuous evidence of their presence, and the engravings on the surface of the wood remain long after the bark has fallen away to reveal the nature of the former insect inhabitants. These galleries are often typical of the species that produced them, particularly so if the host tree is identified, for the beetles are often quite specific in their host requirements. This fact, together with the fact that identification by morphological characters of beetles so small is particularly difficult for the layman, has prompted the construction of the following key, based upon the nature and position of the gallery and the host, as an aid in field identification of our species of scolytids.

FIELD KEY TO THE MINNESOTA BARK BEETLES

Care must be taken to select typical galleries. For instance, polygamous species usually construct radiate or star-shaped galleries, but some of the burrows may be found with two or even one egg gallery. Radiate burrows may have egg galleries long and parallel with the grain, and care must be taken to distinguish these from the simple longitudinal type of burrow.

1. Ambrosia beetles, boring characteristically dark-stained tunnels in the wood ... 2
   Other types of galleries. If boring in the wood, found in drier limbs and twigs ... 10
2. Larval cradles present ... 4
   Larval cradles absent; in hardwoods ... 3
3. Burrows not over 1 mm. in diameter ... *Xyleborus xylographus*
   Burrows 1.25 mm. in diameter; in hickory ... *Xyleborus celsus*
   Burrows 1.8 mm. in diameter ... *Anisandrus obesus*
4. In conifers ... 5
   In hardwoods ... 6
5. Burrows about 1 mm. in diameter, lightly stained ... *Gnathotrichus materiarius*
   Burrows 1.5 mm. or more in diameter, darkly stained ... *Trypodendron*
6. Beetles attacking the underground portions of stems of sapling maples and a variety of shrubs ... *Corthylus punctatissimus*
   Boring in trunks of dying and recently dead trees ... 7

7. Burrows less than or about 1 mm. in diameter .... *Monarthrum*
Burrows 1.5 mm. in diameter or larger 8
8. Larval cradles in a single row above and below the egg gallery; in birch and aspen 9
Larval cradles usually in double rows above and below the egg gallery; in many hardwoods occasionally including birch and aspen .... *Xyloterinus politus*
9. In aspen (and probably other poplars) .... *Trypodendron retusum*
In birch .... *Trypodendron betulae*
10. In coniferous trees 11
In deciduous trees 33
In taproot of clover .... *Hylastinus obscurus*
11. In pine cones 12
Under bark or in twigs 13
12. In cones of Norway pine .... *Conophthorus resinosae*
In cones of white pine .... *Conophthorus coniperda*
13. Characteristic of twigs and smaller limbs 26
Breeding in trunk and bole 14
14. Minute species; galleries arise from those of larger species .... *Crypturgus*
Not as above; entrance holes at surface of the bark 15
15. Burrows longitudinal 16
Burrows radiate 21
16. Egg galleries often quite long, usually in base of trunk, or even underground; eggs not laid singly in niches 18
Egg galleries seldom over two inches in length; eggs laid singly in niches 17
17. Single longitudinal gallery, in arborvitae .... *Phloeosinus canadensis*
A similar gallery in red cedar .... *Phloeosinus dentatus*
Forked (usually) longitudinal gallery, in tamarack, spruce, or balsam fir, especially the first .... *Scolytus piceae*
18. Large stout beetles, constructing burrows with a diameter several times the width of the beetle (irregular elongate type), but mostly refilled with borings, leaving the usual tunnel which just accommodates the beetle; eggs laid in large groups in egg grooves 19
Burrows of the usual type of construction; eggs laid in egg pockets or grooves 20
19. Larvae excavating individual mines; in spruce .... *Dendroctonus piceaperda*
Larvae working in congress to excavate a common chamber instead of individual mines .... *Dendroctonus valens*
(Galleries of *D. rufipennis* are apparently similar to those of *valens* [see Watson, 1931]. This species is recorded from pines, but Minnesota specimens referred to it are from spruce. It is much rarer than *valens* and is a somewhat smaller beetle, with elytra red, and head and thorax black.)
20. Egg gallery 2 to 3 inches long, in base of trunk and roots of pine, spruce, and tamarack; eggs usually laid in grooves but sometimes in pockets as well .... *Hylurgops pinifex*
(The galleries of *Hylastes porculus* perhaps will occur here in the key. It is a slenderer, black insect, breeding in the same situations as *Hylurgops pinifex.)*
Egg galleries much longer, not confined to the ground level; eggs laid in pockets; in tamarack .... *Dendroctonus simplex*

21. Pupal cell constructed entirely within the sapwood 22
    Pupal cell constructed in the bark, or at cambium 23
22. Eggs deposited in groups of 2 to 6 in egg pockets; larvae often reduce to a powder the inner bark of larger pines, rendering individual galleries indistinguishable .... *Orthotomicus caelatus*
    Eggs laid singly in niches .... *Orthotomicus vicinus*
23. Egg galleries tending to become transverse 24
    Egg galleries disregarding the grain of the wood, or becoming parallel to it 25
24. Strongly transverse galleries in balsam fir .... *Pityokteines sparsus*
    In spruce, tamarack, and pines .... *Polygraphus rufipennis*
25. Galleries engraving the surface of the wood .... *Ips*
    (*Ips calligraphus* constructs long longitudinal egg galleries of large diameter in thick-barked pine; *perturbatus* galleries are similar but somewhat smaller, in white spruce, and *chagnoni* burrows slightly smaller than *perturbatus,* in pines. *Ips pini,* a most common species, has medium-sized, more truly radiate galleries, in pines and spruce. The galleries of *Ips borealis* in spruce and *perrotti* in pines are of smaller diameter than those of *pini* and found in the thin-barked crowns, or trunks of small trees.)
    Galleries entirely in the bark .... *Dryocoetes*
26. Egg galleries constructed in the pith of twigs 27
    Egg galleries constructed under the bark, as usual 29
27. A minute species found in even the smallest twigs of white pine .... *Pityophthorus puberulus*
    Larger insects, in larger twigs of pine 28
28. Larvae enlarging the egg gallery to form a common excavation in the pith and wood .... *Myeloborus*
    Not as above .... *Pityophthorus pulicarius*
29. Burrow of the cave type, in limbs of balsam fir near the juncture of a twig, often nearly encircling the base of the latter .... *Cryphalus balsameus*
    Not as above 30
30. Gallery of forked transverse type, in limbs of white spruce *Phthorophloeus piceae*
    Gallery more or less radiate 31
31. Egg galleries becoming longitudinal .... *Pityophthorus*
    Egg galleries becoming transverse, in smaller limbs often spiral about the limb 32
32. In white pine .... *Pityogenes hopkinsi*
    In Norway pine .... *Pityogenes plagiatus*
33. Burrows constructed in the wood or pith of twigs 38
    Burrows constructed in bark or at cambium layer 34
34. Galleries radiate; in limbs of sumach and maple .... *Pityophthorus rhois*
    Galleries radiate; in inner bark of birch .... *Dryocoetes betulae*
    Galleries simple, longitudinal 35
    Galleries transverse 37
35. In hackberry .... *Scolytus muticus*
    In apple, *Crataegus* or *Prunus* .... *Scolytus rugulosus*
    In hickory 36
36. Smaller galleries, in branches .... *Chramesus hicoriae*
    Larger galleries, in trunk or larger limbs .... *Scolytus quadrispinosus*

37. In *Alnus crispa* .... *Trypophloeus nitidus*
In ash .... *Leperisinus*
In elm .... *Hylurgopinus rufipes*
In oak limbs .... *Pseudopityophthorus minutissimus*
In hackberry limbs .... *Phthorophloeus dentifrons*
In peach or cherry limbs .... *Phthorophloeus liminaris*
38. Pith burrows, in oak twigs .... *Micracis opacicollis*
Burrows in wood 39
39. In sapwood of willow .... *Micracis swainei*
In sapwood of dead and dry limbs of maple and apple .... *Lymantor decipiens*

MORPHOLOGICAL CHARACTERS

The family Scolytidae is a member of the Rhynchophora, the most familiar members of which are the weevils or snout beetles. The Rhynchophora are distinguished from other beetles by the absence of a gula. The gular sutures, separated in other beetles, are therefore confluent in a median line on the ventral side of the head. (See Plate II.) The Scolytidae are distinguished from the other Rhynchophora by the following combination of characters: Beak small, not prolonged; tibiae with a series of teeth on the outer margin, or with a curved apical spine; antennae elbowed, hardly longer than the head, with an elongate scape and a compact or rarely laminate club; palpi rigid; head narrower than the thorax; first segment of the anterior tarsus shorter than the following three united; body short, cylindrical, or rarely oval.

To facilitate interpretation of the characters in the following keys to the genera and species, labelled dorsal and ventral views of *Dryocoetes affaber* and structural characters of certain other species are illustrated.

KEY TO THE GENERA KNOWN OR LIKELY TO OCCUR IN MINNESOTA

The North American species of the family Scolytidae are divided into four subfamilies, all of which are represented in our fauna. The following key, adapted chiefly from Swaine (1918), also Blackman (1928), will distinguish the subfamilies and the genera known or likely to occur in our fauna.

1. The anterior tibiae produced into a prominent curved spine at the outer apical angle (Plate IV, A); venter of abdomen abruptly ascending behind .... (Scolytinae) *Scolytus*
Anterior tibiae not strongly produced at outer apical angle 2
2. Head concealed from above by the pronotum (Plate III, A and B) except that the oral region is visible in males of *Trypodendron;* pronotum usually strongly roughened in front (Plate III, A) 16
Base of head visible as seen from above; pronotum not noticeably more roughened in front (Plate IV, K) .... (Hylesinae) 3
3. Length 1 mm.; antennal funicle of two segments .... *Crypturgus*
Moderate to large species; antennal funicle of more than 3 segments 4

4. 3rd foretarsal segment cylindrical, not widened (Plate III, C); fore coxae nearly contiguous 5
   3rd foretarsal segment widened and emarginate or bilobed (Plate III, D and E) 7
5. Eye divided; antennal club unsegmented (Plate IV, K) .... *Polygraphus*
   Eye not divided; antennal club segmented (Plate II) 6
6. Eyes rather deeply, narrowly emarginate; antennal scape slightly longer than the funicle .... *Carphoborus*
   Eyes feebly sinuate in front, hardly emarginate; antennal scape shorter than the funicle; tibiae marginated with long slender teeth .... *Pseudocryphalus*
7. Antennal club unsegmented, funicle attached to its side (Plate IV, F) *Chramesus*
   Antennal club segmented, funicle attached to its base 8
8. Antennal club loosely segmented, the segments produced on one side, sublamellate (Plate IV, G) .... *Phthorophloeus*
   Antennal club connate, the segments equal-sided (Plate IV, H) 9
9. Funicle 5-segmented 10
   Funicle 7-segmented 11
10. Fore coxae very narrowly separated; larger species, usually more than 4.5 mm. long .... *Dendroctonus*
    Fore coxae moderately separated (as in Plate III, H); species less than 3 mm. long .... *Phloeosinus*
11. Fore coxae rather widely separated (Plate III, H) 12
    Fore coxae narrowly separated 15
12. Body clothed with scales; antennal club strongly compressed; elytral declivity not strongly descending; venter of abdomen bent upwards behind .... *Leperisinus*
    Body clothed chiefly with hairs; antennal club moderately compressed; elytral declivity steep and abrupt; venter of abdomen not ascending behind 13
13. Antennal club hardly flattened, subconical, 1st segment almost as long as the 2nd and 3rd combined; episterna scaly .... *Scierus*
    Antennal club distinctly but not strongly compressed, first (basal) segment much shorter than 2nd and 3rd combined 14
14. Antennal club with first suture alone strongly chitinized, distinct; both the 1st and 2nd segments longer than the apical two together; distance from front of eyes to base of mandibles much greater than width of eyes .... *Hylastinus*
    Antennal club with first 2 sutures strongly chitinized and distinct, the 2 apical segments together longer than the 2nd; distance between front eyes and base of mandibles hardly greater than width of eyes *Hylurgopinus*
15. 3rd tarsal segment much widened and bilobed (Plate III, E); mesosternum protuberant in front of coxae .... *Hylurgops*
    3rd tarsal segment but little widened and emarginate (Plate III, D); mesosternum not protuberant .... *Hylastes*
16. Fore tibiae subparallel, not serrate on outer margin (Plate IV, B); antennal funicle 6-segmented .... (Micracinae) *Micracis*
    Fore tibiae widened distally, serrate on outer margin (Plate IV, C-2); funicle with less than 6 segments .... (Ipinae) 17
17. Eye divided; antennal club without distinct sutures (Plate IV, I and J) 18
    Eye not divided; antennal club with sutures at least at tip (Plate III, A and B) 19

18. The corneous basal segment of antennal club broadly arcuate in front (Plate IV, I); males scarce, smaller than females, with front convex *Xyloterinus*
The corneous basal segment of antennal club strongly angulate in front and produced toward the middle (Plate IV, J); males subequal in size to females, front deeply excavated .... *Trypodendron*
19. Antennal funicle with less than 3 segments; fore tibiae scarcely widened distally (Plate IV, D) 20
Antennal funicle with more than 3 segments; fore tibiae more or less strongly widened distally (Plate IV, C) 21
20. Elongate species; funicle of 2 segments, the 2nd smaller and closely attached to the club; fore tibiae with transverse ridges or asperities on outer face, serrate on entire outer margin (Plate IV, D) .... *Monarthrum*
Stout species; funicle of only one segment; fore tibiae without transverse ridges or asperities on outer face, strongly serrate distally on outer margin .... *Corthylus*
21. Body clothed with scales or short scale-like hairs; pronotum armed with comparatively few, large, isolated spine-like or tuberculate asperities (more numerous in *Trypophloeus)*; small species 22
Body clothed with hairs, often nearly glabrous; pronotum with numerous small asperities or more or less distinct granules in front 25
22. Pronotum not acutely margined on sides; antennal club much longer than wide; pronotum with rather numerous isolated asperities, smaller than usual .... *Trypophloeus*
Pronotum acutely margined on sides; antennal club but little longer than wide 23
23. Elytra feebly striate; funicle 4-segmented .... *Cryphalus*
Elytra deeply striate 24
24. Antennal scape 4-segmented, the 4th segment narrow .... *Hypothenemus*
Antennal scape 5-segmented in the female, 4-segmented in the male, the last segment wide .... *Stephanoderes*
25. Pronotum not margined behind; metepisternum distinct for its entire length (Plate II) 30
Pronotum finely margined with a transverse beaded raised line near the caudal border; metepisternum largely covered by the elytra, visible only in front (when the elytra are in the normal tightly closed position) (Plate III, A) 26
26. Pronotum with an acute, arcuate, transverse short carina at its summit, which is before the middle; mouthparts as seen from below clothed with slender hairs .... *Gnathotrichus*
Pronotum without a carina at its summit, which is usually median in position; mouthparts as seen from below densely clothed with stiff hairs 27
27. Body moderately to very stout; sutures of antennal club not septate; pronotal asperities usually extending behind the middle at the sides 28
Body slender to moderately stout; antennal club with sutures 1 and 2 septate; pronotum with a distinct transverse impression behind the summit, asperities usually not extending behind the middle at the sides 29
28. Body very stout; pronotum with anterior margin scarcely if at all serrate, the contour of the disc evenly convex and without a transverse impression behind the summit; elytra with 9th interspace usually not notably elevated .... *Conophthorus*

Body moderately stout; pronotum with anterior margin moderately to strongly serrate, disc with a distinct though not strongly developed transverse impression behind the summit; elytra with 9th interspace usually strongly developed .... *Myeloborus*

29. Pronotum and elytra finely and densely punctulate and with very fine, usually dense pubescence; the greater development of frontal hairs a male character; basal segment of antennal club much narrower than the others .... *Pseudopityophthorus*

Pronotum and elytra finely to coarsely, more sparsely punctured and pubescent; the greater development of frontal hairs a female character .... *Pityophthorus*

30. Antennal funicle 4-segmented, the club compressed, with arcuate sutures on the outer and inner faces .... *Lymantor*

Antennal funicle of 5 segments (Plate II) 31

31. Pronotum precipitous or oblique in front, asperate before the summit (as in Plate III, A), punctured behind 32

Pronotum feebly convex, subequally in front and behind, not declivitous in front, granulate over the entire surface (Plate III, B) .... *Dryocoetes*

32. Fore tarsi only moderately widened distally (Plate IV, C); mouthparts clothed with many stiff hairs; elytral declivity usually toothed or excavated or both; true bark beetles 33

Fore tarsi strongly widened distally (Plate IV, E); mouthparts with sparse, slender hairs; prosternum very short behind the coxae; males rare, dissimilar to females; ambrosia beetles 36

33. Prosternal intercoxal process long and acute (Plate III, F); front not deeply excavated in either sex; antennal club usually without sutures on inner side or only at the extreme tip 34

Prosternum very short and oblique before the coxae (Plate III, G), the intercoxal process short, wide, not extending far between the coxae; front of female usually deeply excavated; antennal club with sutures on both sides .... *Pityogenes*

34. The concavity of the declivity separated from the apical margin of the elytra by the strongly produced, horizontal, plate-like acute apical margin of the declivity (Plate IV, L); antennal club flattened, sutured throughout on the outer face .... *Ips*

The declivity with the apical margin only slightly produced, at most forming a very short acute apical ridge, the plate dividing the declivital apex from the elytral apex, when present, oblique and very short; antennal club thickened at base, obliquely truncate distally on outer face 35

35. The front of the female not densely clothed with long yellow hair; declivital concavity separated from the elytral apical margin by a complete margin, usually acute and distinct, though not strongly produced; antennal club usually longer than wide, thick at base, the oblique truncate distal face steep .... *Orthotomicus*

The front of the female densely clothed with very long yellow hair; declivital concavity less pronounced with the apical declivital margin almost absent toward the middle of the apex so that the sutural sulci extend to the apical margin of the elytra; antennal club usually wider than long, strongly depressed distally .... *Pityokteines*

36. Body very stout; pronotum subcircular with the cephalic margin serrate at the middle line in the females; mesepimeron strongly widened laterally; metepisternum very faintly emarginate behind .... *Anisandrus*
Body slender; pronotum not serrate on the cephalic margin; mesepimeron feebly widened laterally, the sides subparallel; metepisternum rather strongly emarginate on inner side behind .... *Xyleborus*

NOTES ON THE SPECIES

In the following pages the heading "Specimens Examined" refers to the Minnesota specimens of each species that is represented in the University collection. The writer has additional specimens of many of the species in his personal collection. To economize space, reference to the collector and to the date the specimens were collected is omitted. The latter is of little significance for these insects, because most of the species can be found in their burrows at any time of the year.

Only the more important references are cited for each species. These references were chosen to indicate (1) synonymy, (2) general accounts of the species, and (3) significant publications on biology. Swaine's catalog of the North American scolytids gives a complete bibliography for each species prior to the date of its publication (1909).

SCOLYTINAE

Scolytus Geoffrey

Of the six North American genera of the subfamily Scolytinae, the genus *Scolytus* is the only one represented in our fauna, the others being restricted for the most part to the southern Atlantic and Gulf states. *Scolytus* is well characterized by the venter of the abdomen abruptly ascending behind. Of the four species represented in our fauna, two, *Scolytus rugulosus* and *S. quadrispinosus,* have played an important rôle in our economic literature; however, neither of these seems to be abundant in this state. *Scolytus multistriatus,* an introduced European species, attacks elms in the East, and is of grave importance in its rôle of transmitting the Dutch elm disease.

The genus has been revised by Blackman (1934), from which the following key is adapted.

Key to the Minnesota Species

1. Elytra clothed with hairs over the entire surface, striae and interspaces about equally impressed; abdominal sternites unarmed in both sexes, the 2nd not concave 2
Elytral disc glabrous; one or more of the abdominal sternites tuberculate or armed with spines, at least in the male 3
2. Smaller, less than 2.5 mm. long; elytra with short hairs; 5th sternite not sulcate in either sex; breeds in various Rosaceae .... *Scolytus rugulosus* (Ratzeburg)

Larger, usually about .4 mm. long; elytra with long hairs; 5th sternite of male with median sulcus; breeds in *Celtis* .... *Scolytus muticus* Say

3\. 2nd abdominal sternite, in male at least, deeply concave; venter of male with 4 acute spines, of female unarmed. A larger species, breeding in hickory .... *Scolytus quadrispinosus* Say

2nd sternite verticle or oblique, not concave, armed with a tubercle or spine in both sexes, the spine with base not attaining the posterior margin. In conifers .... *Scolytus piceae* (Swaine)

Scolytus rugulosus (Ratzeburg)

1839 *Eccoptogaster rugulosus,* Ratzeburg, Die Forst-insekten 1(2) :187
1909 *Eccoptogaster rugulosus,* Swaine, Cat. Scolytidae, p. 106
1913 *Eccoptogaster rugulosus,* Gossard, Orchard Bark Beetles, pp. 6-30
1916 *Scolytus rugulosus,* Blatchley and Leng, Rhynch. N. E. Amer., p. 590
1918 *Eccoptogaster rugulosus,* Swaine, Can. Bark Beetles, p. 52
1934 *Scolytus rugulosus,* Blackman, Revis. Study *Scolytus,* p. 10

Specimens Examined.—Four, Olmsted County.

Hosts.—Apple, pear, peach, *Prunus* (in literature).

Morphological Characters.—Readily distinguished by its small size, less than 2.5 mm., the elytra uniformly covered with short hairs, and the elytral interspaces as deeply impressed as the striae.

Biology.—There is probably one complete and a partial second generation in the northern states. In the South two or more generations occur per season. The beetle is monogamous, that is, a single pair of adults occupy a burrow, which has a single longitudinal gallery.

Economic Importance.—This species is usually of secondary importance, but if numerous enough it will attack and kill apparently healthy trees. Introduced from Europe, it has become widely distributed in this country, but is not common in Minnesota.

Scolytus muticus Say

1824 *Scolytus muticus,* Say, Jour. Acad. Nat. Sci. Phila., 3:323
1909 *Eccoptogaster muticus,* Swaine, Cat. Scolytidae, p. 104
1916 *Scolytus muticus,* Blatchley & Leng, Rhynch. N. E. America, p. 590
1934 *Scolytus muticus,* Blackman, Revis. Study, *Scolytus,* p. 11

Specimens Examined.—One, Houston County; one, Redwood County; one, Grey Cloud Island (Washington County).

Host.—Hackberries (*Celtis occidentalis* in this state).

Biology.—In Houston County this species was found associated with *Phthorophloeus dentifrons* in a broken limb. Burrows were found in limbs of as small a diameter as half an inch, and both the adult and larval galleries necessarily scored the wood very deeply. The egg galleries are of the unbranched longitudinal type, and all observed were darkly stained, resembling somewhat the galleries of an ambrosia beetle. There is one generation a year, the insect overwintering as mature larvae. This species is of secondary importance only.

Scolytus quadrispinosus Say

1824 *Scolytus quadrispinosus,* Say, Jour. Acad. Nat. Sci. Phila. **3**:323
1867 *Scolytus caryae,* Riley, Prairie Farmer **19**:68-69
1905 *Scolytus quadrispinosus,* Felt, Ins. Aff. Park and Woodland Trees **1**:275
1909 *Eccoptogaster quadrispinosus,* Swaine, Cat. Scolytidae, p. 105
1916 *Scolytus quadrispinosus,* Blatchley & Leng, Rhynch. N. E. Amer., p. 588
1924 *Eccoptogaster quadrispinosus,* Blackman & Stage, Succ. Insects Hickory, pp. 135-143
1934 *Scolytus quadrispinosus,* Blackman, Revis. Study *Scolytus,* p. 16

Hosts.—Various species of hickory.

Specimen Examined.—One, St. Paul.

Economic Importance.—Because of the limited range of its host tree in this state, this insect can never become dangerous. In the East it is a most serious enemy of hickories, attacking living trees in two manners—breeding in them, and feeding on the bases of the petioles, thus killing the leaves.

Scolytus piceae (Swaine)

1910 *Eccoptogaster piceae,* Swaine, Can. Ent. **42**:33-35
1916 *Scolytus piceae,* Blatchley & Leng, Rhynch. N. E. Amer., p. 589
1918 *Eccoptogaster piceae,* Blackman & Stage, Notes Insects Larch, pp. 49-55
1934 *Scolytus piceae,* Blackman, Revis. Study *Scolytus,* p. 26

Specimens Examined.—Thirty, Mille Lacs County; 2, Ramsey County. Galleries have been observed in Anoka and Chisago counties, and at Itasca Park.

Hosts.—Our specimens all from tamarack, *Larix laricina.* Recorded hosts include balsam fir and spruces.

Biology.—This is the only species of our fauna that breeds in conifers, and it differs further in habits from our other species by being normally bigamous, the galleries being of the forked longitudinal type. The specimens from Ramsey County were associated with *Dendroctonus simplex* in dying tamarack; those from Mille Lacs County were brood emerging from the parent tree on July 2. Eight days later only a few specimens could be found.

HYLESINAE

With exception of *Hylastinus obscurus,* which possibly occurs, all our members of this subfamily are true bark beetles, constructing their burrows at the juncture of the bark and wood.

Crypturgus Erichson

The species of this genus are the smallest of the Hylesinae and possess the interesting habit of starting their burrows not from the surface of the bark, but from the gallery walls of some larger species of scolytid. Although no specimens have been taken in this state, two species are likely to occur. They may be distinguished as follows:

1. Pronotum strongly rounded on the sides, suboval; sutural striae suddenly and strongly impressed on basal 4th; pronotal punctures moderately large and deep .... *Crypturgus atomus* LeConte

Pronotum with sides nearly parallel on basal half, much more strongly narrowed in front than behind the middle; sutural striae feebly impressed throughout; pronotal punctures very small and numerous, rather strongly impressed .... *Crypturgus borealis* Swaine

Crypturgus atomus LeConte

1868 *Crypturgus atomus,* LeConte, Trans. Amer. Ent. Soc. 2:152
1906 *Crypturgus atomus,* Felt. Ins. Aff. Park & Woodland Trees 2:359
1909 *Crypturgus atomus,* Swaine, Cat. Scolytidae, p. 94
1918 *Crypturgus pusillus,* Blackman & Stage, Notes Ins. Larch, pp. 55-59
(Here *atomus* is considered synonymous with the European *pusillus.)*
1918 *Crypturgus atomus,* Swaine, Canadian Bark Beetles, p. 54

Distribution.—Recorded from Nova Scotia and the Eastern states to the Great Lakes. The writer has taken it at Clintonville, Wisconsin, associated with *Dendroctonus simplex* and *Polygraphus rufipennis* in tamarack, and *Pityokteines sparsus* in balsam fir.

Crypturgus borealis Swaine

1917 *Crypturgus borealis,* Swaine, Can. Bark Beetles, pt. 1, p. 7
1918 *Crypturgus borealis,* Swaine, Can. Bark Beetles, pt. 2, p. 55

Distribution.—The Great Lakes to the British Columbia coast (Swaine, 1918).

Polygraphus Erichson

Polygraphus rufipennis (Kirby)

1837 *Apate (Lepisomus) rufipennis,* Kirby, Fauna Bor.-Amer. 4:193
1837 *Apate (Lepisomus) nigriceps,* Kirby, Fauna Bor.-Amer. 4:194
1837 *Apate (Lepisomus) brevicornis?,* Kirby, Fauna Bor.-Amer.4:194
1853 *Polygraphus saginatus,* Mannerheim. Bul. Moscou 26:237
1905 *Polygraphus rufipennis,* Felt, Ins. Aff. Park & Woodland Trees 2:386
1909 *Polygraphus rufipennis,* Swaine, Cat. Scolytidae, p. 141
1916 *Polygraphus rufipennis,* Blatchley & Leng, Rhynch. N. E. Amer., p. 661
1918 *Polygraphus rufipennis,* Swaine, Can. Bark Beetles, p. 55
1929 *Polygraphus rufipennis,* Simpson, Can. Ent. 61:146-151

Specimens Examined.—Seventy-three, Itasca Park (including Lake Itasca); 1, Olmsted County; 1, Hubbard County; 6, Mille Lacs County; 7, Lake County; 1, Hennepin County; 10, Cloquet; 14, Ely (Halfway Ranger Station).

Hosts.—Tamarack, white spruce, black spruce, Norway pine, white pine, and "balsam." The last record is considered erroneous, for reasons given under the discussion of *Ips borealis.*

Morphological Characters.—Length 2-3 mm.; body stout. Easily recognized by its divided eyes and unsegmented antennal club.

Economic Importance.—Swaine (1918) states that this species frequently becomes a more or less primary enemy of black spruce and white spruce.

Carphoborus Eichoff

Pseudocryphalus Swaine

No specimens of *Carphoborus* or *Pseudocryphalus* are known from this state, but it is possible that both genera do occur. *Carphoborus carri* Swaine and *Pseudocryphalus criddlei* Swaine are both known from Aweme, Manitoba, the former breeding in white spruce and the latter (see Swaine, 1917 and 1918) in *Prunus virginiana.*

Chramesus LeConte

Chramesus hicoriae LeConte

1868 *Chramesus hicoriae,* LeConte, Trans. Amer. Ent. Soc. 2:168
1906 *Chramesus hicoriae,* Felt, Ins. Aff. Park & Woodland Trees 2:448-449
1909 *Chramesus hicoriae,* Swaine, Cat. Scolytidae, p. 68
1916 *Chramesus icoriae,* Blatchley and Leng, Rhynch. N. E. Amer., p. 660
1922 *Chramesus hicoriae,* Blackman, Miss. Bark Beetles, p. 50
1924 *Chramesus hicoriae,* Blackman & Stage, Succ. Ins. Hickory, pp. 143-150

DISTRIBUTION.—A common species in the East. Blackman and Stage (1924) state that it has been recorded from Minnesota, but no Minnesota specimens have been seen by the writer.

HOSTS.—Hickories.

Phthorophloeus Rey

The species of this genus are small in size, usually less than 2.25 mm. long, and readily distinguished from other members of the family by the lamelliform antennal club. They breed in dead twigs and limbs, constructing burrows of the forked transverse type.

Key to the Minnesota Species

1. Antennal club with the laterally extended segments more than twice as wide as their length at base .... *Phthorophloeus liminaris* (Harris)

   Antennal club with the laterally extended segments not more than twice as wide as their length at base 2

2. Smaller, 1.2 to 6 mm. long; antennal club with the laterally extended segments about twice as wide as long; elytral interspaces not strongly elevated nor serrate .... *Phthorophloeus dentifrons* Blackman

   Larger, 2 to 2.25 mm. long; antennal club with the laterally extended segments about as wide as long; elytral interspaces strongly elevated and serrate with granules which become large and prominent on the declivity, especially about the sides .... *Phthorophloeus piceae* Swaine

Phthorophloeus liminaris (Harris)

1852 *Tomicus liminaris,* Harris, Rept. Ins. Inj. Veg., p. 78
1906 *Phloeotribus liminaris,* Felt, Ins. Aff. Park & Woodland Trees 2:452
1909 *Phloeotribus liminaris,* Swaine, Cat. Scolytidae, p. 131
1913 *Phloeotribus liminaris,* Gossard, Orchard Bark Beetles, pp. 31-43
1916 *Phloeophthorus liminaris,* Blatchley & Leng, Rhynch. N. E. Amer., p. 657
1918 *Phthorophloeus liminaris,* Swaine, Can. Bark Beetles, p. 60
1922 *Phthorophloeus liminaris,* Blackman, Miss. Bark Beetles, p. 55

SPECIMENS EXAMINED.—One, Olmsted County.

HOSTS.—Peach and wild cherry (in literature).

ECONOMIC IMPORTANCE.—This species is sometimes injurious to peach orchards in the Eastern states. Because of its habit of constructing short hibernation burrows in the bark it may damage healthy trees considerably.

Phthorophloeus dentifrons Blackman

1921 *Phthorophloeus dentifrons,* Blackman, Miss. Ag. Exp. Sta. Tech. Bul. **10**:3

1922 *Phthorophloeus dentifrons,* Blackman, Miss. Bark Beetles, p. 55

Specimens Examined.—Thirty, Goodhue County; 69, Washington County; 34, Houston County.

Host.—Hackberry, *Celtis occidentalis.*

Biology.—This species breeds abundantly in the smaller dead branches of hackberry and is of no economic importance. In Mississippi, from where this species was described, Blackman (1922) states that there are probably two generations per year, and the adults hibernate in the same limbs which served them as a larval host.

Phthorophloeus piceae (Swaine)

1911 *Phloeotribus piceae,* Swaine, Can. Ent. **43**:220

1918 *Phthorophloeus piceae,* Swaine, Can. Bark Beetles, p. 59

Specimens Examined.—Three, Lake County near Ely; gallery at Itasca Park.

Host.—White spruce limbs.

Dendroctonus Erichson

Our largest and most destructive bark beetles are members of this genus, which, with exception of the European *Dendroctonus micans,* is strictly American. The members of this genus were an especial subject of investigation for Dr. A. D. Hopkins, former Chief of Forest Insect Investigations of the Bureau of Entomology. His researches are well reported in two publications (Hopkins 1909a and 1909b), the former giving morphological details and taxonomy, and the latter giving practical information about the species.

Key to the Minnesota Species

1. Smaller, average size about 4.7 mm.; epistomal process narrow, extending to the anterior margin of epistoma, its sides nearly parallel; in tamarack .... *Dendroctonus simplex* LeConte

   Length usually over 5 mm.; epistomal process wide, shorter than the epistoma, its sides strongly oblique and anterior margin concave 2

2. Front without median posterior impression; punctures of the pronotum large and shallow, fairly regular in size; larger, reddish species........ *Dendroctonus valens* LeConte

Front with a median posterior impression; punctures of the pronotum deep and small, more or less evidently intermixed with larger ones 3

3\. The caudal half of the proepisternal area granulate, with punctures indistinct; color varying from unicolorous to nearly as in *rufipennis* .... *Dendroctonus piceaperda* Hopkins

The caudal half of the proepisternal area distinctly though sparsely punctured and feebly roughened; color of mature adult black, with elytra deep red .... *Dendroctonus rufipennis* (Kirby)

Dendroctonus simplex LeConte

1868 *Dendroctonus simplex,* LeConte, Trans. Amer. Ent. Soc. 2:173
1909 *Dendroctonus simplex,* Swaine, Cat. Scolytidae, p. 99
1909 *Dendroctonus simplex,* Hopkins, Genus *Dendroctonus,* pp. 117-121
1909 *Dendroctonus simplex,* Hopkins, Barkbeetles *Dendroctonus,* pp. 103-106
1916 *Dendroctonus simplex,* Blatchley & Leng, Rhynch. N. E. Amer., p. 653
1918 *Dendroctonus simplex,* Blackman & Stage, Notes Ins. Larch, pp. 39-49
1918 *Dendroctonus simplex,* Swaine, Can. Bark Beetles, pp. 62-63

Specimens Examined.—Two, Carlton County; 29, Hennepin County; 6, Mille Lacs County; 33, Ramsey County; 2, Lake Itasca; 3, Pine River; 1, St. Paul.

Host.—Tamarack, *Larix laricina.*

Biology.—There is but one generation a year, and the brood overwinters in the tree in which it was reared. One dying tree in Ramsey County contained a few mature larvae and numerous pupae and recently transformed adults on June 26. In localities where tamarack is the only conifer that occurs this is often the only scolytid found breeding in it. Associated insects include *Polygraphus rufipennis, Scolytus piceae, Crypturgus atomus, Orthotomicus caelatus, Platysoma* sp., and clerid larvae. The last two are predatory.

Economic Importance.—Though often of secondary importance, this species may be a primary factor in the death of trees, and the writer has observed numerous trees in Ramsey and Hennepin counties that were dead or dying from the attacks of this insect. In all but one tree this was the only bark beetle found.

Dendroctonus piceaperda Hopkins

1901 *Dendroctonus piceaperda,* Hopkins, U. S. Div. Ent. Bull. 28, p. 16, pl. 2
1906 *Dendroctonus piceaperda,* Felt, Ins. Aff. Park & Woodland Trees 2:379
1909 *Dendroctonus piceaperda,* Hopkins, Genus *Dendroctonus,* pp. 126-130
1909 *Dendroctonus piceaperda,* Hopkins, Barkbeetles *Dendroctonus,* pp. 114-125

1916 *Dendroctonus piceaperda,* Blatchley and Leng, Rhynch. N. E. Amer., p. 653
1918 *Dendroctonus piceaperda,* Swaine, Can. Bark Beetles, p. 66

SPECIMENS EXAMINED.—Three, Itasca Park.

HOST.—White spruce (Minnesota), all spruces of its range.

ECONOMIC IMPORTANCE.—In the spruce forests of the New England states this insect has taken heavy toll, particularly of red spruce. In Minnesota it is obviously rare, only three specimens taken by Dr. Graham having been seen. Hopkins (1909a), in his distributional map, records it from the northeastern tip of this state, but makes no mention of Minnesota localities in his paragraph on distribution.

Dendroctonus rufipennis (Kirby)

1837 *Hylurgus rufipennis,* Kirby, Fauna Bor.-Amer. **4**:195
1909 *Dendroctonus rufipennis,* Hopkins, Genus *Dendroctonus,* pp. 138-140
1909 *Dendroctonus rufipennis,* Hopkins, Barkbeetles *Dendroctonus,* pp. 136-138
1918 *Dendroctonus rufipennis,* Swaine, Can. Bark Beetles, p. 64
1931 *Dendroctonus rufipennis,* Watson, Can. Ent. **63**:126-127

SPECIMENS EXAMINED.—Six, International Falls.

HOSTS.—Previously recorded only from pines. Our specimens were sent in by Forest Ranger Hartwell, who reported them attacking white spruce.

Dendroctonus valens LeConte

1860 *Dendroctonus valens,* LeConte, Pac. R. R. Explor. Ins. **12**(2):59
1909 *Dendroctonus valens,* Hopkins, Genus *Dendroctonus,* pp. 151-157
1909 *Dendroctonus valens,* Hopkins, Barkbeetles *Dendroctonus,* pp. 153-165
1916 *Dendroctonus valens,* Blatchley & Leng, Rhynch. N. E. Amer., p. 654
1918 *Dendroctonus valens,* Swaine, Can. Bark Beetles, p. 63

SPECIMENS EXAMINED.—One, Aitkin; 9, Carlton County; 2, Cloquet; 1, Duluth; 6, Lake Superior; 3, Olmsted County; 316, Itasca Park (including Lake Itasca); 2, Plummer; 2, Roseau County; 1, Two Harbors.

HOSTS.—All native pines (in Minnesota); recorded in literature from pines, tamarack, spruces, and fir.

MORPHOLOGICAL CHARACTERS.—This is our largest member of the family, varying from 5.7 mm. to 9 mm. in length.

ECONOMIC IMPORTANCE AND HABITS.—This species is recorded by Hopkins (1909b) to breed in the bases of healthy trees, thus killing portions of the bark and leaving scars which are often taken for fire damage. Beetles have been taken by the writer from their tunnels in the bases of healthy Norway pine at Cloquet. Their presence was indicated by large exudations of pitch from the entrance tunnels. The galleries of the adults are longitudinal and more or less irregular. The larvae work in congress, excavating a common chamber in which individual galleries are indistinguishable.

Phloeosinus Chapuis

One species of this genus has been taken in Minnesota, while two others possibly occur.

Phloeosinus canadensis Swaine

1917 *Phloeosinus canadensis,* Swaine, Can. Bark Beetles, pt. 1, p. 8
1918 *Phloeosinus canadensis,* Swaine, Can. Bark Beetles, pt. 2, pp. 69-70

Specimens Examined.—Six, Poplar Lake (Cook County); 8, Aitkin County. Galleries have been observed at Itasca Park and at Cooper's Bog in Anoka County.

Host.—Arborvitae, *Thuja occidentalis.*

Phloeosinus dentatus (Say)

1826 *Hylurgus dentatus,* Say, Jour. Acad. Nat. Sci. Phila. 5:258
1868 *Dendroctonus graniger,* Eichhoff, Berlin. Ent. Zeit. 12:147
1868 *Dendroctonus haagi,* Eichhoff, Berlin. Ent. Zeit. 12:148
1868 *Dendroctonus serratus,* LeConte, Trans. Amer. Ent. Soc. 2:170
1906 *Phloeosinus dentatus,* Felt, Ins. Aff. Park & Woodland Trees 2:391-393
1909 *Phloeosinus dentatus,* Swaine, Cat. Scolytidae, p. 129
1922 *Phloeosinus dentatus,* Blackman, Miss. Bark Beetles, p. 60

This species breeds in red cedar and possibly occurs in southeastern Minnesota.

Phloeosinus pini Swaine

1915 *Phloeosinus pini,* Swaine, Can. Ent. 47:362
1918 *Phloeosinus pini,* Swaine, Can. Bark Beetles, p. 69

Described from Riding Mountains, Manitoba, breeding in jack pine.

Leperisinus Reitter

The members of this genus are thickly clad with broad scales. The elytral declivity is gradually descending behind and the venter of the abdomen elevated behind. With exceptions of a California species which breeds in olive, all appear to breed in ash. Their burrows are of the forked transverse type. Though often very abundant, they appear to be of secondary importance only.

Key to the Minnesota Species

1. The median interstrial row of the elytral pubescence much longer than the surrounding scales, hair-like on the sides, and broadly spatulate on the declivity; sides of pronotum very strongly asperate; color markings indistinct .... *Leperisinus imperialis* (Eichhoff)

   The median interstrial row of the elytral pubescence much longer than the surrounding scales, not conspicuously hair-like on the sides 2

2. Length 3.5 to 4 mm.; the asperities on the sides and cephalic margin of pronotum very feebly developed; elytral interspaces coarsely, closely, uniseriately asperate .... *Leperisinus pruinosus* (Eichhoff)

   Length 3 mm. or less; asperities on the sides and cephalic margin of the pronotum rather coarse 3

3. The pronotal asperities few in number, near the lateral margin, usually mostly before the middle, those of the submarginal row in front lunular; the pronotum only very feebly emarginate in front; striae and strial punctures distinct, with a median row of scales on the interspaces slightly longer than the others, more distinct on the declivity; the basal transverse pale band on the elytra continuous .... *Leperisinus aculeatus* (Say)

   The pronotal asperities numerous, extending to the caudal margin and upon the disc, those of the submarginal row in front elongate and subarcuate; pronotum rather strongly emarginate on middle line in front; striae and strial punctures almost entirely hidden by the scales; the median row of slightly longer scales hardly visible on the interspaces even on the declivity; the basal transverse band on the elytra absent on the 3rd and 5th interspaces .... *Leperisinus criddlei* Swaine

Leperisinus imperialis (Eichhoff)

1868 *Hylesinus imperialis,* Eichhoff, Berlin. Ent. Zeit. **12**:149
1909 *Hylesinus imperialis,* Swaine, Cat. Scolytidae, p. 112
1918 *Leperisinus imperialis,* Swaine, Can. Bark Beetles, p. 71

No Minnesota specimens of this species are known, but it has been recorded from Wisconsin and the Dakotas.

Leperisinus pruinosus (Eichhoff)

1868 *Hylesinus pruinosus,* Eichhoff, Berlin. Ent. Zeit. **12**:149
1909 *Hylesinus pruinosus,* Swaine, Cat. Scolytidae, p. 112
Here listed as a synonym of *Hylesinus aculeatus* Say.
1918 *Leperisinus imperialis,* Swaine, Can. Bark Beetles, p. 71

Specimen Examined.—One, Olmsted County.

Leperisinus aculeatus (Say)

1824 *Hylesinus aculeatus,* Say, Jour. Acad. Nat. Sci. Phila. **3**:332
1905 *Hylesinus aculeatus,* Felt, Ins. Aff. Park & Woodland Trees **1**:288-289
1909 *Hylesinus aculeatus,* Swaine, Cat. Scolytidae, p. 111
1916 *Hylesinus aculeatus,* Blatchley & Leng, Rhynch. N. E. Amer., p. 663
1918 *Leperisinus aculeatus,* Swaine, Can. Bark Beetles, p. 72
1922 *Leperisinus aculeatus,* Blackman, Miss. Bark Beetles, pp. 62-63

SPECIMENS EXAMINED.—Thirty-three, Mankato; 1, Minneapolis; 4, Olmsted County; 2, St. Paul. Galleries have been observed at Itasca Park, Luverne, and Washington County.

HOSTS.—Ash, *Fraxinus* spp.

BIOLOGY.—There is one generation a year, the adults leaving their parent tree in midsummer and passing the winter in short hibernating burrows constructed in the bark of healthy trees.

Leperisinus criddlei Swaine

1918 *Leperisinus criddlei,* Swaine, Can. Bark Beetles, p. 72

SPECIMEN EXAMINED.—One, Ramsey County.

Scierus LeConte
Scierus annectens LeConte

1876 *Scierus annectens,* LeConte, Proc. Amer. Phil. Soc. **15**:390
1909 *Scierus annectens,* Swaine, Cat. Scolytidae, p. 144
1918 *Scierus annectens,* Swaine, Can. Bark Beetles, p. 73

DISTRIBUTION.—Known from British Columbia to eastern Quebec, and should occur in the northern part of this state.

HOST.—White spruce.

MORPHOLOGICAL CHARACTERS.—Reddish-brown, opaque; pronotum wider than long, strongly punctured.

Hylastinus Bedel
Hylastinus obscurus (Marsham)

This is a pest introduced from Europe which tunnels in the roots of clovers, especially red clover. A detailed bulletin of this insect was published by Rockwood (1926). In some sections of the East and of the Pacific Northwest this beetle has caused serious damage to clover crops, particularly in the second crop year. It should occur in this state, although it is not definitely known to. In Rockwood's distributional

Specimen Examined.—One, St. Paul (Battlecreek Park).

Host.—Willow, *Salix* sp.

Biology.—The gallery of this species penetrated the wood at a point where the bark was roughened. The entrance tunnel was 4 mm. long, giving rise to two tunnels which divided again to form a total of five branches. This gallery system penetrated the wood to a depth of three-eighths of an inch and extended longitudinally for a distance of one and one-eighth inch. There was no nuptial chamber. Egg niches occurred at irregular intervals, but the wood was very dry, the beetles dead, and no brood found. The gallery was in wood infested with *Cryptorhynchus lapathi.*

Micracis opacicollis LeConte

1878 *Micracis opacicollis,* LeConte, Proc. Amer. Phil. Soc. **17**:625
1878 *Micracis asperulus,* LeConte, Proc. Amer. Phil. Soc. **17**:626
1909 *Micracis opacicollis,* Swaine, Cat. Scolytidae, p. 127
1920 *Micracis opacicollis,* Blackman, Miss. Agr. Expt. Sta. Tech. Bul. **9**:33-34
1922 *Micracis opacicollis,* Blackman, Miss. Bark Beetles, pp. 70-71

Specimens Examined.—One, Olmsted County; 14, Ramsey County.

Host.—White oak.

Biology.—The beetle was found in dead and very dry sprouts less than a quarter of an inch in diameter. The entrance gallery is constructed beside a bud, usually in its axil, and extends directly to the pith. From this point it continues along the pith, usually in both directions, and, in all cases observed, for a distance of less than an inch. However, nearly all the beetles were dead when found, and no evidences of reproduction were observed, though a pair was often found in a gallery.

IPINAE

This subfamily is best represented in our fauna with regard to the number of genera and species. In habits it is quite diverse, the majority of the members being true bark beetles, but there are several groups of genera that are ambrosia beetles, and a few species breed in wood, pith of twigs, or pine cones.

Xyloterinus Swaine

Xyloterinus politus (Say)

1826 *Bostrichus politus,* Say, Jour. Acad. Nat. Sci. Phila. **5**:256
1868 *Xyloterus politus,* LeConte, Trans. Amer. Ent. Soc. **2**:159
1905 *Xyloterus politus,* Felt, Ins. Aff. Park & Woodland Trees. **1**:292-293

1909 *Trypodendron politus,* Swaine, Cat. Scolytidae, p. 149-150
1916 *Xyloterus politus,* Blatchley & Leng, Rhynch. N. E. Amer., p. 645
1918 *Xyloterinus politus,* Swaine, Can. Bark Beetles, p. 83
1922 *Xyloterinus politus,* Blackman, Miss. Bark Beetles, pp. 78-79

Specimens Examined.—Twenty-eight, Hennepin County; 1, Olmsted County; 5, Ramsey County; 1, St. Paul; 1, Washington County; 42, Winona County. Also observed in Lake County and at Itasca Park.

Hosts.—A great many deciduous trees. In this state it has been taken from oak, red oak, paper birch, and aspen.

Biology.—The burrows are constructed in the moist sapwood of dying or recently dead trees, usually in the basal region of the trunk. They are darkly stained with ambrosia fungus, upon which the insect and its larvae feed. Each larva constructs a short tunnel about three-sixteenths of an inch long and with the grain of the wood, perpendicular to the egg gallery. In this gallery, or larval cradle, the larva lives, feeds, and pupates. The larval cradles are closely spaced characteristically, thus tending to arrange themselves in double rows above and below the egg gallery.

Trypodendron Stephens

Species of this genus are ambrosia beetles, some breeding in conifers, others in deciduous trees. The males are subequal in size to the females and have the front broadly excavated. The beetles are monogamous, and construct galleries quite similar to *Xyloterinus,* except that the larval cradles are less crowded and arranged in a single perpendicular row above and below the egg gallery.

Key to the Minnesota Species[1]

1. The carina forming the lateral margin of the declivital sulcus wide and irregularly punctured; pronotum entirely black, closely granulate on the median part of the disc behind; elytral declivity distinctly hairy 2
   The carina forming the lateral wall of the declivity sulcus narrow and uniseriately punctate or granulate-punctate; pronotum punctured across the middle line near the caudal border, at most but sparsely granulate; declivity sparsely and indistinctly hairy 3
2. Length 3.5 to 4 mm.; declivity sulcus wide and deep, gradually narrowed on the caudal half; elytra with brilliant luster; the male with the cephalic margin of the pronotum broadly emarginate as viewed from above; host aspen .... *Trypodendron retusum* (LeConte)
   Length 3 to 3.5 mm.; declivital sulcus rather narrow and its sides nearly parallel; elytra with rather dull luster; male pronotum broadly arcuate in front; in birch .... *Trypodendron betulae* Swaine

[1] Several specimens of a *Trypodendron* species were taken by the writer from jack pine at Ely, associated with *T. rufitarsus.* They are somewhat larger than the latter, and darker. They may be a new species. There are also four apparently identical specimens in the University collection taken from *Pinus resinosa* at Bemidji.

3. Interspace 2 of the declivity punctured and usually as wide as interspace 1 and interspace 3, which are distinctly granulate; pronotum with a basal pale transverse band; elytra with longitudinal pale bands, striae with punctures shallow and usually small................*Trypodendron bivitattum* (Kirby)
   Interspace 2 very narrow on declivity and impunctate, interspace 2 and 3 with granules nearly obsolete; pronotum and elytra with an obscure, smoky, reddish median area..................................*Trypodendron rufitarsus* (Kirby)

Trypodendron retusum (LeConte)

1868 *Xyloterus retusus,* LeConte, Trans. Amer. Ent. Soc. 2:158
1909 *Trypodendron retusus,* Swaine, Cat. Scolytidae, p. 150
1916 *Xyloterus retusus,* Blatchley & Leng, Rhynch. N. E. Amer., p. 645
1918 *Trypodendron retusus,* Swaine, Can. Bark Beetles, p. 85
1920 *Trypodendron retusum,* Leng, Cat. Col. Amer. N. of Mexico, p. 379

SPECIMENS EXAMINED.—Four, Lake County near Ely; 39, Lake Itasca and Itasca Park; 16, Hennepin County.

HOSTS.—Aspen, *Populus tremuloides,* and probably other species of *Populus.* Upon two occasions a pair has been found tunneling in paper birch. In one case the tunnels were of full length and in the other they were nearly so, but no brood or eggs were found in either instance, and this does not appear to be a successful host tree, though their fungus grew well.

BIOLOGY.—The beetle is monogamous, a pair constructing a burrow consisting of an entrance gallery and a pair of egg galleries at a depth of usually less than an inch from the surface of the wood. Occasionally, when the egg galleries are completed, the entrance burrow will be extended to a greater depth and more egg galleries constructed. From observations at Clintonville, Wisconsin, it appears that the brood leaves the tree in the fall. Nothing is known concerning the hibernation of this species.

Trypodendron betulae Swaine

1911 *Trypodendron betulae,* Swaine, Can. Ent. 43:216
1918 *Trypodendron betulae,* Swaine, Can. Bark Beetles, p. 85

SPECIMENS EXAMINED.—Seventy-one, Lake Itasca and Itasca Park; 3, Ramsey County; 1, Winona County (Latsch State Park).

HOST.—Paper birch, *Betula papyrifera.*

BIOLOGY.—The galleries are like those of *Trypodendron retusum* but are of smaller diameter and extend more deeply into the wood.

Trypodendron bivittatum (Kirby)

1837 *Apate bivittata,* Kirby, Fauna Bor.-Amer. 4:192, pl. 8, fig. 5
1906 *Xyloterus bivittatus,* Felt, Ins. Aff. Park & Woodland Trees 2:369
1909 *Trypodendron bivittata,* Swaine, Cat. Scolytidae, p. 148
The American species is here considered synonymous with the European *Trypodendron lineatus.*
1916 *Xyloterus lineatus,* Blatchley & Leng, Rhynch. N. E. Amer., p. 646
1918 *Trypodendron bivittatum,* Swaine, Can. Bark Beetles, p. 85

Specimens Examined.—Seven, Ely (Halfway Ranger Station); 3, Itasca Park.

Hosts.—Black spruce and Norway pine. Has been recorded from many other conifers.

Trypodendron rufitarsus (Kirby)

1837 *Apate rufitarsus,* Kirby, Fauna Bor.-Amer. 4:193
1909 *Trypodendron rufitarsus,* Swaine, Cat. Scolytidae, p. 149
Here considered a synonym of *Trypodendron lineatus.*
1918 *Trypodendron rufitarsus,* Swaine, Can. Bark Beetles, p. 85

Specimens Examined.—Seven, Ely (Halfway Ranger Station).

Host.—Jack pine.

Monarthrum Kirsch

Two species represent this genus in the eastern United States. One of these occurs in Minnesota; the other probably will be found here. They are small, elongate ambrosia beetles.

Monarthrum mali (Fitch)

1856 *Tomicus mali,* Fitch, 3rd Rept. Nox. Ins. N. Y., pp. 326-327
1868 *Pterocyclon longulum,* Eichhoff, Berlin. Ent. Zeit. 12:278
1905 *Monarthrum mali,* Felt, Ins. Aff. Park & Woodland Trees 1:289-292
1909 *Pterocyclon mali,* Swaine, Cat. Scolytidae, p. 143
1916 *Monarthrum mali,* Blatchley and Leng, Rhynch. N. E. Amer., p. 641
1918 *Pterocyclon mali,* Swaine, Can. Bark Beetles, p. 87
1920 *Monarthrum mali,* Leng, Cat. Col. Amer. N. of Mexico, p. 339
1922 *Pterocyclon mali,* Blackman, Miss. Bark Beetles, pp. 80-81

Specimens Examined.—Two, Olmsted County; 5, Hopkins; 7, Hennepin County; 10, Washington County.

Hosts.—Red oak, oak, maple. Has been recorded from many deciduous trees.

Morphological Characters.—Length 2.2 to 2.7 mm.; color uniform light to dark brown.

Monarthrum fasciatum (Say)

1826 *Bostrichus fasciatus,* Say, Jour. Acad. Nat. Sci. Phila. **5**:255
1868 *Pterocyclon simile,* Eichhoff, Berlin. Ent. Zeit. **12**:277
1909 *Pterocyclon fasciatus,* Swaine, Cat. Scolytidae, p. 142
1916 *Monarthrum fasciatum,* Blatchley & Leng, Rhynch. N. E. Amer., p. 641
1918 *Pterocyclon fasciatum,* Swaine, Can. Bark Beetles, p. 86
1922 *Pterocyclon fasciatum,* Blackman, Miss. Bark Beetles, p. 61

Specimens Examined.—None have been seen from Minnesota, but Blatchley and Leng record it from Lake Superior, and the writer has taken it at Iowa City, Iowa.

Morphological Characters.—A somewhat larger species distinguished from *mali* by a basal paler area on the elytra, and the elytral declivity densely pubescent.

Corthylus Erichson

Corthylus punctatissimus (Zimmerman)

1868 *Crypturgus punctatissimus,* Zimmerman, Trans. Amer. Ent. Soc. **2**:144
1905 *Corthylus punctatissimus,* Felt, Ins. Aff. Park & Woodland Trees **1**: 65-67
1909 *Corthylus punctatissimus,* Swaine, Cat. Scolytidae, p. 91
1916 *Corthylus punctatissimus,* Blatchley & Leng, Rhynch. N. E. Amer., p. 642

Specimens Examined.—Four, Hennepin County (Minnetonka Lake); 1, Norman County.

Hosts.—The Minnetonka Lake specimens are from *Acer saccharinum.* This species is recorded in the literature from a large variety of small trees and shrubs, including maples and huckleberry.

Biology.—This species attacks healthy plants at the base of the trunk or stem, the entrance to its galleries being subterranean or concealed by the layer of leaf mold.

Hypothenemus Westwood

This and the following genus are well represented in the southeastern states by a large number of species, breeding for the most part in dead bark or wood of deciduous trees and shrubs. Though each genus is represented from the state by a single specimen, the writer has failed to discover additional material.

Hypothenemus punctifrons Hopkins

1909 *Hypothenemus eruditis,* Swaine, Cat. Scolytidae, p. 117
Until Hopkins (1915) the species went under this name.
1915 *Hypothenemus punctifrons,* Hopkins, Classif. Cryphalinae, p. 18
1922 *Hypothenemus punctifrons,* Blackman, Miss. Bark Beetles, p. 86

Specimen Examined.—One, Ramsey County.

Stephanoderes Eichhoff
Stephanoderes dissimilis (Zimmerman)

1868 *Crypturgus dissimilis,* Zimmerman, Trans. Amer. Ent. Soc. 2:144
1909 *Hypothenemus dissimilis,* Swaine, Cat. Scolytidae, p. 116
1916 *Stephanoderes dissimilis,* Blatchley and Leng, Rhynch. N. E. Amer., p. 603
1922 *Stephanoderes dissimilis,* Blackman, Miss. Bark Beetles, pp. 89-90

Specimen Examined.—One, Olmsted County.

Cryphalus Erichson
Cryphalus balsameus Hopkins

1915 *Cryphalus balsameus,* Hopkins, Classif. Cryphalinae, p. 41
1916 *Cryphalus balsameus,* Blatchley and Leng, Rhynch. N. E. Amer., p. 607
1918 *Cryphalus balsameus,* Swaine, Can. Bark Beetles, p. 89

Specimens Examined.—Eleven, Itasca County.

Host.—Balsam fir, *Abies balsamea.*

Biology.—This species was taken from a dead broken limb hanging from a balsam. The beetles construct their burrows in the bark of the limb at the juncture of a twig, often nearly encircling the base of the latter. The exact nature of the galleries was not observed.

Trypophloeus Fairmaire
Trypophloeus nitidus Swaine

1912 *Trypophloeus nitidus,* Swaine, Can. Ent. 44:349
1918 *Trypophloeus nitidus,* Swaine, Can. Bark Beetles, p. 90

Specimens Examined.—Thirty-one, Lake County near Ely.

Host.—*Alnus crispa.*

Morphological Characters.—Two mm. long; black, pubescent; the prothorax relatively small and triangular, viewed from above.

Biology.—This species was described from Weymouth, Nova Scotia, in alder. It was found in abundance in dying stems of *Alnus crispa* in Lake County, near Ely, Minnesota, September 10, 1936. Brown frass usually protrudes from the entrance holes, which are congregated on the under side of the stem if the latter is not perpendicular. The egg galleries are transverse often nearly encircling the stem. The larvae feed entirely upon the bark and work in congress, so that individual larval mines are indistinguishable until the larvae are nearly mature.

The insect was found only in dying stems of *Alnus crispa,* and could not be found in *Alnus incana* in a similar state of health growing in the same vicinity. Though a primary factor in the death of its host, it is not of economic importance, for its host is a small shrub and of no value. In the burrows of this insect were found several imagoes and a nymph of a large black thrips, and a number of specimens of the nitidulid, *Glischrochilus siepmanni,* were taken from infested branches, attracted by the sap which exudes from the entrance burrows.

Specimens of the adults and larvae and of the galleries are in the University of Minnesota collection.

Gnathotrichus Eichhoff

Gnathotrichus materiarius (Fitch)

1858 *Tomicus materiarius,* Fitch, 4th Rept. Nox. Ins. N. Y. pp. 40-42
1868 *Gnathotrichus corthyloides,* Eichhoff, Berlin. Ent. Zeit. **12**:273
1906 *Gnathotrichus materiarius,* Felt, Ins. Aff. Park and Woodland Trees **2**:371-372
1909 *Gnathotrichus materiarius,* Swaine, Cat. Scolytidae, p. 108
1916 *Gnathotrichus materiarius,* Blatchley and Leng, Rhynch. N. E. Amer., p. 643
1918 *Gnathotrichus materiarius,* Swaine, Can. Bark Beetles, p. 91
1922 *Gnathotrichus materiarius,* Blackman, Miss. Bark Beetles, pp. 95-96

Specimens Examined.—Seven, Aitkin; 1, Cass Lake; 1, Cloquet; 4, Lake Itasca and Itasca Park; 1, Olmsted County.

Hosts.—White pine, Norway pine, jack pine. Recorded in literature from other conifers.

Morphological Characters.—Length about 3 mm.; elongate; dark brown, shining.

Biology.—Though an ambrosia beetle, its galleries and the surrounding wood are not darkly stained. The tunnels often extend into the wood to a considerable depth.

Conophthorus Hopkins

The species of this genus are very stout and are unique in their habit of infesting pine cones. Two species are known from the East. When abundant, the adults may be found attacking the buds of their host tree.

Conophthorus niperda (Schwarz)

1895 *Pityophthorus coniperda,* Schwarz, Proc. Ent. Soc. Wash. 3:144-145
1909 *Pityophthorus coniperda,* Swaine, Cat. Scolytidae, p. 134
1915 *Conophthorus coniperda,* Hopkins, Jour. Wash. Acad. Sci. 5:429, 432
1916 *Pityophthorus coniperda,* Blatchley and Leng, Rhynch. N. E. Amer., p. 634
1918 *Conophthorus coniperda,* Swaine, Can. Bark Beetles, p. 93

Specimens Examined.—Two, Fillmore County; 15, St. Anthony Park.

Host.—White pine, *Pinus strobus.*

Conophthorus resinosae Hopkins

1915 *Conophthorus resinosae,* Hopkins, Jour. Wash. Acad. Sci. 5:431
1918 *Conophthorus resinosae,* Swaine, Can. Bark Beetles, p. 93

Host.—Norway pine, *Pinus resinosa.*

No record is known of this species from this state, but it may occur.

Pseudopityophthorus Swaine

Pseudopityophthorus minutissimus (Zimmerman)

1868 *Crypturgus minutissimus,* Zimmerman, Trans. Amer. Ent. Soc. 2:143
1905 *Pityophthorus minutissimus,* Felt, Ins. Aff. Park and Woodland Trees 1:295
1909 *Pityophthorus minutissimus,* Swaine, Cat. Scolytidae, p. 139
1916 *Pityophthorus minutissimus,* Blatchley and Leng, Rhynch. N. E. Amer. p. 628
1918 *Pseudopityophthorus minutissimus,* Swaine, Can. Bark Beetles, p. 94
1931 *Pseudopityophthorus minutissimus,* Blackman, Jour. Wash. Acad. Sci. 21:231

Specimens Examined.—Three, Houston County; 1, Olmsted County; 5, Winona County. Galleries have also been observed in Ramsey and Washington counties.

Hosts.—Oaks, *Quercus* spp.

Biology.—This species breeds in the limbs; the egg galleries are transverse and score the wood very deeply. The larval mines are longitudinal and occur entirely in the bark.

Myeloborus Blackman

Although no members of this genus have been taken, two may possibly occur in Minnesota. *Myeloborus ramiperda* (Swaine) breeds in white pine and is known from Maine and Michigan; *M. fizavi* Blackman breeds in Norway pine and was described from New York and Wisconsin. Detailed observations on the biology of the latter species are given by Blackman (1928, pp. 24-26). They infest the lower and intermediate branches of small trees, killing healthy twigs. The eggs are laid in the pith and the larvae hollow out the pith and the surrounding wood, forming a communal chamber.

Pityophthorus Eichhoff

This is the largest genus of Scolytidae, both in this state and in the country as a whole. Its species occur for the most part in coniferous trees, though a few are characteristic of deciduous trees and shrubs. They breed in the smaller limbs and twigs. Most of them are true bark beetles, though under crowded conditions the larvae may bore into and pupate in the pith, and at least one species constructs its egg galleries in the pith or wood.

The genus was revised by Blackman (1928). From this revision is taken the following key, which will serve to distinguish the species thus far known from this state.

Key to the Minnesota Species

1. Elytra with punctures of striae 1 and 2 not strongly reduced on the declivity, 2nd interspace not widened; small species 2
   Elytral declivity with punctures of striae 1 and 2 usually considerably reduced or even obsolete; interspace 2 decidedly sulcate, usually widened 4
2. Declivity strongly sulcate; strial punctures in definite rows, strongly developed on the declivity; in broadleaved trees and shrubs, chiefly *Rhus* spp. .... *Pityophthorus rhois* Swaine
   Declivity feebly sulcate, with punctures of striae 1 and 2 slightly to moderately reduced in size but still distinct in at least stria 2 3
3. Elytra with strial punctures moderately small but deep, not in regular rows, interspaces shining, with punctures numerous .... *Pityophthorus puberulus* (LeConte)
   Elytra with strial punctures fine and shallow, in regular or nearly regular rows, interspaces finely, densely rugulose, very sparsely punctured .... *Pityophthorus* sp., near *albertensis* Blackman
4. Elytra very broadly to narrowly rounded behind, not acuminate; front of head in both sexes variously modified 5
   Elytra with apex acuminate or subacuminate, declivity usually strongly sulcate 10
5. Front of head in male longitudinally carinate, that of female variously modified and either finely pubescent or with moderate to long hairs; antennal club with first suture at least weakly, the others more strongly arcuate 6
   Front of head in male transversely carinate; usually also with evident longitudinal carina; that of female usually with long hairs; sutures one and two of antennal club straight or weakly arcuate 9
6. Stout species; usually coarsely, densely, often confusedly punctured; interstrial punctures numerous; antennal club broad oval, widest through the second segment, sutures arcuate 7

Slender species, nearly or quite 3 times as long as wide; elytra with strial punctures in nearly regular rows, those of the interspaces less numerous and usually smaller; male with the summit of the lateral convexities moderately displaced mesially; front of head in female not concave, ornamented by a spongy pubescent area lighter in color, much wider than long, and divided in a median line by a rather wide sulcus .... *Pityophthorus mundus* Blackman

7. Elytra coarsely, densely, confusedly punctured, with little indication of strial rows except deeply sulcate, lateral convexities feebly granulate .... *Pityophthorus pulicarius* (Zimmerman)

Elytra usually coarsely, densely punctured, often somewhat confused, but always showing some evidence of striae; declivity not densely punctured, lateral convexities granulate 8

8. Elytral declivity broadly sulcate and similar in both sexes; front of head in female with moderately long hairs .... *Pityophthorus* sp., near *cognatus* Blackman

Declivity of male with summits of lateral convexities displaced mesially and ornamented with a blunt horn; front of head in the female with fine, short pubescence .... *Pityophthorus cariniceps* LeConte

9. Pronotum moderately rounded in front; female frons with a large flattened area bearing short, sparse hairs, a row of much longer hairs on its periphery .... *Pityophthorus pulchellus* Eichhoff

10. Declivity with sutural and lateral convexities more or less strongly granulate-setose .... *Pityophthorus consimilis* LeConte

Declivity in female without granules or setae, in male with smaller granules and shorter setae or with none .... *Pityophthorus nudus* Swaine

Pityophthorus rhois Swaine

1917 *Pityophthorus rhois,* Swaine, Can. Bark Beetles, pt. 1, p. 26
1918 *Pityophthorus rhois,* Swaine, Can. Bark Beetles, pt. 2, p. 99
1928 *Pityophthorus rhois,* Blackman, Genus *Pityophthorus,* p. 38

Specimens Examined.—Two, Goodhue County; 4, Houston County; 2, Lake Minnetonka; 15, Olmsted County; 22, Washington County; 51, Winona County.

Hosts.—Staghorn sumach. Known from other species of *Rhus*.

Variety *acerni* was described (Blackman, 1928) from *Acer saccharinum* in West Virginia. The burrows of what probably pertain to this insect have been observed in limbs of *Acer saccharinum* at Fort Snelling, Minneapolis. No specimens could be found.

Pityophthorus puberulus (LeConte)

1868 *Cryphalus puberulus,* LeConte, Trans. Amer. Ent. Soc. **2**:157
1871 *Pityophthorus infans,* Eichhoff, Berlin. Ent. Zeit. **15**:135
1909 *Pityophthorus puberulus,* Swaine, Cat. Scolytidae, p. 137
1916 *Pityophthorus pulicarius,* Blatchley & Leng, Rhynch. N. E. Amer., p. 629
1918 *Pityophthorus puberulus,* Swaine, Can. Bark Beetles, p. 99
1928 *Pityophthorus puberulus,* Blackman, Genus *Pityophthorus,* pp. 48-49

SPECIMENS EXAMINED.—Two, Aitkin; 20, Cass Lake; 1, Cass County; 67, Cloquet; 2, Crow Wing County.

HOSTS.—Norway pine, jack pine, white pine. Recorded in literature from balsam fir and spruce.

MORPHOLOGICAL CHARACTERS.—Length 1.4 to 1.6 mm.; black; with short, erect pubescence.

BIOLOGY.—This common species is usually found under the bark of twigs, but in the smallest twigs of white pine it is found in the pith.

Pityophthorus sp. near *albertensis* Blackman

Two series of specimens, one from Cass Lake and the other from Lake County near Ely, are allied to *Pityophthorus albertensis,* which was described from Alberta, host unknown. The former series was from Norway pine twigs, associated with *P. puberulus;* the latter occurred with *Phthorophloeus piceae* in limbs of white spruce.

Pityophthorus pulicarius (Zimmerman)

1868 *Crypturgus pulicarius,* Zimmerman, Trans. Amer. Ent. Soc. **2**:144
1909 *Pityophthorus pulicarius,* Swaine, Cat. Scolytidae, p. 138
1916 *Pityophthorus pulicarius,* Blatchley & Leng, Rhynch. N. E. Amer., p. 629
1918 *Pityophthorus pulicarius,* Swaine, Can. Bark Beetles, p. 99
1928 *Pityophthorus pulicarius,* Blackman, Genus *Pityophthorus,* p. 63

SPECIMEN EXAMINED.—One, Cloquet.

HOST.—Norway pine.

Pityophthorus sp. near *cognatus* Blackman

SPECIMEN EXAMINED.—One, Cloquet.

HOST.—Norway pine.
Pityophthorus cognatus is known from pines in North Carolina.

Pityophthorus cariniceps LeConte

1876 *Pityophthorus cariniceps,* LeConte, Proc. Amer. Phil. Soc. **15**:353
1909 *Pityophthorus cariniceps,* Swaine, Cat. Scolytidae, p. 134
1916 *Pityophthorus cariniceps,* Blatchley & Leng, Rhynch. N. E. Amer., p. 633
1918 *Pityophthorus cariniceps,* Swaine, Can. Bark Beetles, p. 102
1928 *Pityophthorus cariniceps,* Blackman, Genus *Pityophthorus,* pp. 72-74

Specimens Examined.—Five, Washington County.

Host.—White pine.

Biology.—This species was found in quarter-inch fallen twigs of white pine. Because of the size of the beetles and the thinness of the bark of the material they were breeding in, the egg galleries scored the wood very deeply. It was the only scolytid found in pines in that locality, which contained only a few scattered trees.

Pityophthorus mundus Blackman

1928 *Pityophthorus mundus,* Blackman, Genus *Pityophthorus,* pp. 86-88

Specimens Examined.—Ten, Cloquet.

Host.—Norway pine.

This species was described from New York and New Hampshire, in red spruce.

Pityophthorus pulchellus Eichhoff

1868 *Pityophthorus pulchellus,* Eichhoff, Berlin. Ent. Zeit. 12:275
1878 *Pityophthorus hirticeps,* LeConte, Proc. Amer. Phil. Soc. 17:623, 665
1909 *Pityophthorus pulchellus,* Swaine, Cat. Scolytidae, p. 138
1916 *Pityophthorus pulchellus,* Blatchley & Leng, Rhynch. N. E. Amer., p. 632
1918 *Pityophthorus pulchellus,* Swaine, Can. Bark Beetles, p. 102
1928 *Pityophthorus pulchellus,* Blackman, Genus *Pityophthorus,* p. 110

Specimens Examined.—Eight, Cloquet.

Host.—Norway pine.

Pityophthorus consimilis LeConte

1878 *Pityophthorus consimilis,* LeConte, Proc. Amer. Phil. Soc. 17:622, 665
1909 *Pityophthorus consimilis,* Swaine, Cat. Scolytidae, p. 135
1917 *Pityophthorus granulatus,* Swaine, Can. Bark Beetles, pt. 1, p. 28
1922 *Pityophthorus granulatus,* Blackman, Miss. Bark Beetles, pp. 107-108
1928 *Pityophthorus consimilis,* Blackman, Genus *Pityophthorus,* pp. 131-133

Specimens Examined.—One, Aitkin; 1, Cloquet; 1, Fillmore County; 2, Hubbard County; 1, Washington County.

Hosts.—White pine, Norway pine, jack pine.

Pityophthorus nudus Swaine

1917 *Pityophthorus nudus,* Swaine, Can. Bark Beetles, pt. 1, p. 30
1918 *Pityophthorus nudus,* Swaine, Can. Bark Beetles, pt. 2, p. 104
1922 *Pityophthorus nudus,* Blackman, Miss. Bark Beetles, p. 108
1928 *Pityophthorus nudus,* Blackman, Genus *Pityophthorus,* p. 133

SPECIMENS EXAMINED.—One, Aitkin; 3, Fillmore County; 1, Washington County.

HOST.—White pine.

Pityogenes Bedel

Two species of this genus occur commonly in the eastern states, and both are found in Minnesota. They breed in the limbs and tops of pine. They may be distinguished as follows:

1. The declivity oblique, with 3 pairs of small teeth; the pronotum strongly narrowed on more than the cephalic half, narrowly rounded in front; female with a circular, undivided pit on the front; in white pine .... *Pityogenes hopkinsi* Swaine

   The declivity steep, with 2 pairs of large teeth, the upper pair much larger, elongate and curved in the male; female with a frontal subtriangular pubescent area, divided in median line by a longitudinal carina; in Norway and jack pine .... *Pityogenes plagiatus* (LeConte)

Pityogenes hopkinsi Swaine

1906 *Pityogenes* sp. A, Felt, Ins. Aff. Park & Woodland Trees **2**:374
1915 *Pityogenes hopkinsi,* Swaine, N. Y. St. Col. For. Tech. Publ. 2, **16**(1): 8-10
1915 *Pityogenes hopkinsi,* Blackman, Obs. *P. hopkinsi,* pp. 11-66, 6 pl.
1916 *Pityogenes hopkinsi,* Blatchley & Leng, Rhynch. N. E. Amer., p. 635
1918 *Pityogenes hopkinsi,* Swaine, Can. Bark Beetles, p. 106

SPECIMENS EXAMINED.—Ten, Aitkin; 2, Cass Lake; 1, Cloquet; 4, Fillmore County; 9, Hastings; 7, Hennepin County; 32, Itasca Park and Lake Itasca; 4, Mille Lacs County; 1, Ottertail County; 5, Ponemah; 2, Ramsey County.

HOST.—White pine.

MORPHOLOGICAL CHARACTERS.—Length 2 mm; black, elytra dark reddish-brown.

BIOLOGY.—This beetle is abundant in white pine. It prefers thin-barked limbs, and its galleries are common in limbs of several inches in diameter or stems of sapling trees of that size. It has been found breeding in material as small as half an inch in diameter and in smooth-barked tops nearly five inches in diameter. The beetle is polygamous, five or more egg galleries often radiating from one nuptial chamber. The latter scores the wood in the thinner-barked limbs; in material of about two or more inches in diameter, it is constructed entirely within the bark. In its tunnels the tenebrionid, *Hypophloeus tenuis,* has been taken in Fillmore and Mille Lacs counties. Breeding in the same limbs, *Pityophthorus nudus* and *P. consimilis* are often found, and *Ips pini* occasionally. Detailed observations on the life history and habits of this species are given by Blackman (1915).

Pityogenes plagiatus (LeConte)

1868 *Xyleborus plagiatus,* LeConte, Trans. Amer. Ent. Soc. 2:161
1909 *Pityogenes plagiatus,* Swaine, Cat. Scolytidae, p. 133
1916 *Pityogenes plagiatus,* Blatchley & Leng, Rhynch. N. E. Amer., p. 637
1918 *Pityogenes plagiatus,* Swaine, Can. Bark Beetles, p. 107

SPECIMENS EXAMINED.—Twelve, Cloquet; 6, Hubbard County; 63, Itasca Park and Lake Itasca.

HOSTS.—Norway pine, jack pine.

Ips DeGeer

The species of this genus are distinguished from other genera by the nature of the elytral declivity, which is concave and bordered on the sides by a number of teeth, and especially by an acute, projecting, shelf-like ridge (Plate IV, L). Seven of the species are known from Minnesota.

Key to the Minnesota Species

1. The declivital margin with 6 teeth; size larger, 4.5 to 6.5 mm. .... *Ips calligraphus* (Germar)
   The declivital margin with 5 teeth 2
   The declivital margin with 4 teeth 3
2. Smaller, slender; pronotum decidedly elongate; discal interspaces 2, 3, and 4 impunctate on usually the basal two-thirds, uniseriately punctured behind, but little confused near the declivity .... *Ips grandicollis* (Eichhoff)
   Larger and stouter and more punctured; pronotum only moderately longer than wide, the discal interspaces very sparsely punctured on the basal half, closely punctured on the caudal half and decidedly confused toward the declivity .... *Ips chagnoni* Swaine
3. The discal interspaces impunctate except near the declivity 4
   All the interspaces punctured, uniseriately except near the declivity, the discal interspaces sparsely punctured in *perrotti* 5

4. Larger, 4 to 5.5 mm. long; stout; elytral suture arcuate in profile; in white spruce .... *Ips perturbatus* (Eichhoff)
   Smaller, 3.5 to 4.2 mm. long; elytral suture in profile straight on basal half .... *Ips pini* (Say)
5. Pronotum slender, distinctly longer than wide, with the punctures nearly obsolete on disc; discal interspaces of elytra very sparsely punctured .... *Ips perrotti* Swaine
   Pronotum hardly longer than wide, strongly punctured on disc; discal interspaces with more numerous punctures; front of head almost perfectly smooth and polished .... *Ips borealis* Swaine

Ips calligraphus (Germar)

1824 *Bostrichus calligraphus,* Germar, Ins. Spec. Nov., p. 461
1826 *Bostrichus exesus,* Say, Jour. Acad. Nat. Sci. Phila. **5**:255
1867 *Tomicus praemorsus,* Eichhoff, Berlin. Ent. Zeit. **11**:401
1906 *Tomicus calligraphus,* Felt, Ins. Aff. Park & Woodland Trees **2**:345-351
1909 *Ips calligraphus,* Swaine, Cat. Scolytidae, p. 121
1916 *Ips calligraphus,* Blatchley & Leng, Rhynch. N. E. Amer., p. 638
1918 *Ips calligraphus,* Swaine, Can. Bark Beetles, pt. 2, p. 112
1922 *Ips calligraphus,* Blackman, Miss. Bark Beetles, p. 114

SPECIMENS EXAMINED.—Twenty-five, Aitkin; 12, Cass Lake; 1, Duluth; 4, Friesland; 2, Independence; 59, Itasca Park; 1, Ottertail County.

HOSTS.—White pine, Norway pine, jack pine.

BIOLOGY.—It breeds commonly in stumps and thick-barked pieces of slash, and when numerous enough becomes a primary enemy. It has been noted killing overmature jack pines at Chippewa Falls, Wisconsin, and killing white pine of small sawlog size in the vicinity of Clintonville, Wisconsin. It is a polygamous species, constructing radiate burrows, the egg galleries becoming strongly longitudinal.

Associates of this insect are many. In a white pine stump at Aitkin they included *Dendroctonus valens, Orthotomicus caelatus, Dryocoetes americanus, Gnathotrichus materiarius, Hypophloeus parallelus, Platysoma* sp., and *Thanasimus dubius.* Other insects found associated with it in white pine are *Ips pini, Enoclerus quadriguttatus,* and larvae of *Monochamus* sp. and *Chrysobothris dentipes.* In Norway pine and jack pine, *Ips chagnoni,* as well as many of the previously mentioned species, may be found.

Ips grandicollis (Eichhoff)

1867 *Tomicus grandicollis,* Eichhoff, Berlin. Ent. Zeit. **11**:402
1868 *Tomicus cacographus,* LeConte, Trans. Amer. Ent. Soc. **2**:162
1906 *Tomicus cacographus,* Felt, Ins. Aff. Park & Woodland Trees **2**:356-359
1909 *Ips grandicollis,* Swaine, Cat. Scolytidae, p. 122

1916 *Ips grandicollis,* Blatchley & Leng, Rhynch. N. E. Amer., p. 638
1918 *Ips grandicollis,* Swaine, Can. Bark Beetles, p. 113
1922 *Ips grandicollis,* Blackman, Miss. Bark Beetles, p. 113

Specimens Examined.—Eight, Lake Itasca and Itasca Park; 2, Olmsted County.

Hosts.—The hosts of our specimens are not recorded. It breeds in various pines.

Length.—Three to 3.7 mm.; a slender species, with the pronotum one-third longer than broad.

Ips chagnoni Swaine

1916 *Ips chagnoni,* Swaine, Can. Ent. **48**:186
1918 *Ips chagnoni,* Swaine, Can. Bark Beetles, p. 113

Specimens Examined.—Three, Bemidji; 1, Carlton County; 4, Cass County; 28, Cass Lake; 1, Cloquet; 102, Lake Itasca and Itasca Park; 3, St. Paul.

Hosts.—White pine, Norway pine, jack pine, Scot's pine.

Morphological Characters.—Length 4 to 4.8 mm.; very closely allied to *grandicollis,* but larger, stouter and more coarsely punctured.

Dr. Swaine states in correspondence that this species intergrades with *grandicollis* in New York State, and the same situation seems to obtain in Minnesota. A number of specimens are of intermediate size and sculpturing, and it is very difficult to ascribe them to either species with certainty. Specimens collected by the writer at Cass Lake have definitely the size and shape of *chagnoni,* yet the sculpturing is like *grandicollis.* Of three specimens collected by L. W. Orr at Itasca Park and determined *grandicollis* by Dr. Blackman, the writer considers the one bearing Blackman's label and a second specimen to be *grandicollis,* but the third specimen *chagnoni.* Similarly, three specimens collected by Mr. Orr at Bemidji, March 25, 1935, from litter under a dead Norway pine and determined by him to be *grandicollis* are considered by the writer to be *chagnoni.*

Ips perturbatus (Eichhoff)

1868 *Tomicus perturbatus,* Eichhoff, Berlin. Ent. Zeit. **12**:274
1876 *Tomicus hudsonicus,* LeConte, Proc. Amer. Phil. Soc. **15**:363, 366
1909 *Ips perturbatus,* Swaine, Cat. Scolytidae, p. 124
1918 *Ips perturbatus,* Swaine, Can. Bark Beetles, p. 115

Specimens Examined.—Twenty-six, Ely (Halfway Ranger Station); 16, Lake County, near Ely; 22, Itasca Park.

Host.—White spruce. One specimen is labelled *"Pinus resinosa,"* but *perturbatus* is not known to breed in any tree other than white spruce.

Ips pini (Say)

1826 *Bostrichus pini,* Say, Jour. Acad. Nat. Sci. Phila. **5**:257
1867 *Tomicus praefrictus,* Eichhoff, Berlin. Ent. Zeit. **11**:401
1906 *Tomicus pini,* Felt, Ins. Aff. Park & Woodland Trees **2**:351-354
1909 *Ips pini,* Swaine, Cat. Scolytidae, p. 125
1916 *Ips pini,* Blatchley & Leng, Rhynch. N. E. Amer., p. 639
1918 *Ips pini,* Swaine, Can. Bark Beetles, pp. 115-116

Specimens Examined.—Six, Aitkin; 68, Bemidji; 1, Blackduck; 33, Cass County; 31, Cass Lake; 68, Cloquet; 2, Fillmore County; 21, Ely; 2, Hennepin County; 2, Hubbard County; 506, Itasca Park and Lake Itasca; 6, Mille Lacs County; 1, Olmsted County; 1, Osage; 26, Ramsey County; 1, St. Anthony Park; 6, St. Paul; 2, Staples; 1, Two Harbors; 1, University campus.

Hosts.—White pine, Norway pine, jack pine, Scot's pine, white spruce, black spruce.

Biology.—A common species breeding in the trunks and occasionally in the larger limbs of pines. Although usually a secondary insect, breeding in slash and windfalls or trees dying of other causes, it may be associated with primary insects, thus aiding them in their work. At Cloquet, September 9, 1936, this beetle was observed killing a number of young jack pines, trees of three inches or less diameter. Except for the tenebrionid, *Hypophloeus parallelus,* it was the only insect found in the attacked trees. The injury was caused entirely by feeding, only three egg niches being observed in two trees. The galleries were very irregularly winding and so numerous that the bark had for the most part fallen away, leaving the trunk practically bare from the ground to nearly half way through the crown. The foliage of these trees was still dark green, mute evidence of the intensity and recentness of attack. Beetles were found in the vicinity in the crown of windfalls in branches of an inch in diameter. This is considered unusual, and strengthens the conclusion that the beetle was very abundant in the vicinity. It is believed that the beetles attacking these trees were of the current year's brood and were feeding prior to hibernation. Orr (1935) indicates that this and other species of *Ips* hibernate in the litter at the bases of the brood trees. The writer's observations bear this out, for only a very occasional specimen of *Ips pini* and *Ips calligraphus* has been found under the bark during the month of March, at a time when the beetles were still in hibernation.

Ips perrotti Swaine

1915 *Ips perrotti,* Swaine, Can. Ent. **47**:356, 2 figs.
1916 *Ips perrotti,* Blatchley & Leng, Rhynch. N. E. Amer., p. 639
1918 *Ips perrotti,* Swaine, Can. Bark Beetles, p. 117

Specimens Examined.—Two, Cass Lake; 78, Itasca Park and Lake Itasca; 24, Wadena County.

Hosts.—Jack pine, Norway pine.

Ips borealis Swaine

1911 *Ips borealis,* Swaine, Can. Ent. 43:213
1918 *Ips borealis,* Swaine, Can. Bark Beetles, p. 117

SPECIMENS EXAMINED.—One, Itasca Park.

HOSTS.—Swaine (1918) records this species from white spruce, red spruce, Engelmann's spruce, and doubtfully from balsam fir and hemlock. It is known from this state by a single specimen bearing the label "Itasca Park, Minn., June 4, 1914, Balsam." A series of *Polygraphus rufipennis* bears identical labels. In view of the fact that neither of these species is definitely known to occur in balsam, and that *Pityokteines sparsus,* a species common in balsam, is not represented by specimens bearing identical labels, there is no doubt that the host referred to was actually a spruce, and probably white spruce, for *Ips borealis* has not been recorded from black spruce.

Orthotomicus Ferrari

Key to the Minnesota Species

1. Elytral striae rather strongly impressed; the strial punctures rather coarse and very close; interstrial punctures deep and uniseriate, nearly as large and numerous as those of the striae of the caudal half of the disc, making the interspaces rough; face of the declivity coarsely punctured .... *Orthotomicus caelatus* (Eichhoff)

   Elytral striae feebly impressed, the strial punctures rather small and only moderately close; the interstrial punctures very small on the disc, becoming more numerous and nearly as large as those of the striae near the declivital margin; the discal interspaces rather smooth and shining; declivital face finely punctured .... *Orthotomicus vicinus* (LeConte)

Orthotomicus caelatus (Eichhoff)

1858 *?Tomicus xylographus,* Fitch, 4th Rept. Nox. Ins. N. Y., p. 716
1867 *Tomicus caelatus,* Eichhoff, Berlin. Ent. Zeit. 11:402
1867 *?Tomicus decretus,* Eichhoff, Berlin. Ent. Zeit. 11:402
1906 *Tomicus caelatus,* Felt, Ins. Aff. Park & Woodland Trees 2:354-356
1909 *Ips caelatus,* Swaine, Cat. Scolytidae, p. 120
1916 *Ips caelatus,* Blatchley & Leng, Rhynch. N. E. Amer., p. 640
1918 *Orthotomicus caelatus,* Swaine, Can. Bark Beetles, p. 121

SPECIMENS EXAMINED.—Twenty-two, Aitkin; 3, Bemidji; 4, Carlton County; 4, Cass Lake; 12, Cloquet; 4, Ely (Halfway Ranger Station); 1, Lake County; 61, Itasca Park and Lake Itasca; 3, Mille Lacs County; 4, Olmsted County; 5, St. Paul; 1, Two Harbors.

HOSTS.—White pine, Norway pine, jack pine, Scot's pine, white spruce, black spruce, tamarack.

BIOLOGY.—A species common especially in the thicker-barked bases of pines. Its burrows are radiate, and the eggs are laid in groups of 2 to 6. The larvae often completely reduce the inner bark to powder, thus rendering the nature of the galleries indistinguishable. The mature larvae burrow into the sapwood and there pupate. This is usually a secondary enemy.

Orthotomicus vicinus (LeConte)

1874 *Xyleborus vicinus,* LeConte, Trans. Amer. Ent. Soc., 5:72
1909 *Ips vicinus,* Swaine, Cat. Scolytidae, p. 120
Here considered synonymous with *Ips caelatus.*
1918 *Orthotomicus vicinus,* Swaine, Can. Bark Beetles, p. 122

SPECIMENS EXAMINED.—Twelve, Ely (Halfway Ranger Station).

HOST.—Black spruce.

MORPHOLOGICAL CHARACTERS.—Swaine (1918) says of this species, "This species is doubtfully distinct from *caelatus.* The great majority of our specimens from the region west of the Great Lakes are distinctly of the *vicinus* type, while the eastern specimens are almost invariably of the true *caelatus* type. The true *caelatus* is also represented from Alaska."

BIOLOGY.—To this species is attributed a series of *Orthotomicus* taken from a black spruce windfall. They differ very little from the typical *caelatus* morphologically, but differ distinctly in the nature of their galleries. They are found under the bark of the lower crown portion of the trunk, which was 3 to 4 inches in diameter at this point. The nuptial chamber is large and irregular, measuring 15 mm. in length in one case, with three egg galleries radiating from it, the latter becoming quite longitudinal. The egg galleries measure 1¾ to 2 inches in length in many cases, which is longer than in *caelatus,* but the most outstanding point of contrast is that the eggs are laid singly in niches along both sides of the gallery, as in *Ips.* The adult beetles score the wood heavily; the larvae burrow nearly entirely in the bark until they enter the sapwood to pupate.

Specimens of the adults, larvae, and galleries are deposited in the University of Minnesota collection.

Pityokteines Fuchs

Pityokteines sparsus (LeConte)

1868 *Xyleborus sparsus,* LeConte, Trans. Amer. Ent. Soc. 2:160
1878 *Tomicus balsameus,* LeConte, Proc. Amer. Phil. Soc. 17:625
1906 *Tomicus balsameus,* Felt, Ins. Aff. Park & Woodland Trees 2:375-379
1909 *Pityogenes sparsus,* Swaine, Cat. Scolytidae, p. 133
This species was confused with *Pityogenes hopkinsi* for years.

1909 *Ips balsameus,* Swaine, Cat. Scolytidae, p. 119
1918 *Pityokteines sparsus,* Swaine, Can. Bark Beetles, p. 125

Specimens Examined.—Ten, Aitkin; 21, Lake County; 3, Ely (Halfway Ranger Station); 1, St. Louis County; 83, Itasca Park and Lake Itasca.

Host.—Balsam fir.

Biology.—An abundant species in balsam fir and considered to be a primary enemy. Its burrows are of the radial pattern, the egg galleries becoming strongly transverse. The adult galleries score the wood deeply; the larvae feed and pupate in the inner layers of the bark.

Anisandrus Ferrari

The species of this genus and the following are ambrosia beetles. They differ from other ambrosia beetles in that the larvae do not construct larval cradles, but are reared and pupate in the galleries constructed by their parent. The males are much smaller than the females, differ morphologically from them, and are rare. The males are wingless, short-lived, and do not leave the tree they were reared in.

Anisandrus obesus (LeConte)

1868 *Xyleborus obesus,* LeConte, Trans. Amer. Ent. Soc. **2**:159
1909 *Xyleborus obesus,* Swaine, Cat. Scolytidae, p. 155
1911 *Anisandrus serratus,* Swaine, Can. Ent. **43**:162
1915 *Anisandrus obesus,* Hopkins, Classif. Cryphalinae, p. 69
1916 *Anisandrus obesus,* Blatchley & Leng, Rhynch. N. E. Amer., p. 625
1918 *Anisandrus obesus,* Swaine, Can. Bark Beetles, p. 125

Specimens Examined.—Three, Hennepin County; 23, Ramsey County; 13, Itasca Park.

Hosts.—Paper birch, aspen. Recorded in literature from birches, oaks, maples, and beech.

Morphological Characters.—Length of female 3.3 to 3.7 mm.; color black when mature; body stout. The male is much smaller and delicate, length 1.65 to 1.75 mm.

Biology.—The burrows are contained in the outer half-inch portion of the wood and are biramous. Each burrow is constructed by a single female, who occupies it with her brood. Associated insects are *Trypodendron betulae* in birch; *Trypodendron retusum, Xyloterinus politus,* and *Hylecoetes* in aspen.

Xyleborus Eichhoff

The species of this genus are slender, more elongate beetles than *Anisandrus*. Two species are known from the state.

Xyleborus xylographus (Say)

1826 *Bostrichus xylographus,* Say, Jour. Nat. Sci. Phila. **5**:256
1909 *Xyleborus xylographus,* Swaine, Cat. Scolytidae, p. 157
1916 *Xyleborus xylographus,* Blatchley & Leng, Rhynch. N. E. Amer., p. 621
1918 *Xyleborus xylographus,* Swaine, Can. Bark Beetles, p. 127

Specimens Examined.—Three, Hennepin County; 10, Houston County; 3, Olmsted County; 26, Red Wing; 12, Washington County; 6, Winona County.

Host.—Known from a variety of hardwoods, it has been taken only from oaks in this state.

Morphological Characters.—Female 2.3 to 2.7 mm. long; elongate; brown. The male is subequal in width but shorter than the female, the pronotum with a median longitudinal ridge at its anterior margin.

Xyleborus celsus Eichhoff

1867 *Xyleborus celsus,* Eichhoff, Berlin. Ent. Zeit. **11**:400
1868 *Xyleborus biographus,* LeConte, Trans. Amer. Ent. Soc. **2**:160
1906 *Xyleborus celsus,* Felt, Ins. Aff. Park & Woodland Trees **2**:446-448
1909 *Xyleborus celsus,* Swaine, Cat. Scolytidae, p. 151
1916 *Xyleborus celsus,* Blatchley & Leng, Rhynch. N. E. Amer., p. 623
1918 *Xyleborus celsus,* Swaine, Can. Bark Beetles, p. 128
1922 *Xyleborus celsus,* Blackman, Miss. Bark Beetles, pp. 119-120
1924 *Xyleborus celsus,* Blackman & Stage, Succ. Ins. Hickory, pp. 151-153

Specimen Examined.—One, Olmsted County.

Hosts.—Recorded hosts are various species of *Hicoria.*

Morphological Characters.—A much larger species than *xylographus.* Length of female 4 to 4.5 mm.; first interspace of elytral declivity armed at summit, second interspace bearing two large subequal teeth.

Dryocoetes Eichhoff

Two species of this genus occur in Minnesota, while another should be found.

Key to the Minnesota Species

1. The ventral surface with coarse, round, shallow punctures; the pronotum usually widest at or near the middle; interstrial punctures of the elytra much smaller and finer than those of the striae 2

The ventral surface finely punctate; pronotum widest well behind the middle and much more strongly narrowed in front than behind; interstrial punctures nearly as coarse and numerous as those of the striae .... *Dryocoetes affaber* (Mannerheim)

2. Females with front only sparsely hairy; elytral declivity convex; in conifers .... *Dryocoetes americanus* Hopkins

Females with front densely pubescent with long reddish hairs; declivity strongly flattened, with first two striae impressed; in birch .... *Dryocoetes betulae* Hopkins

Dryocoetes americanus Hopkins

1909 *Dryocoetes autographus,* Swaine, Cat. Scolytidae, p. 131
Previous to Hopkins (1915) this species went under the name of the European *Dryocoetes autographus.*
1915 *Dryocoetes americanus,* Hopkins, Classif. Cryphalinae, p. 51
1916 *Dryocoetes americanus,* Blatchley & Leng, Rhynch. N. E. Amer., p. 612
1918 *Dryocoetes americanus,* Swaine, Can. Bark Beetles, p. 132

Specimens Examined.—One, Aitkin; 1, Frontenac; 9, Lake Itasca and Itasca Park; 1, Olmsted County; 1, Two Harbors.

Hosts.—White pine, Norway pine, white spruce. Breeds in a variety of conifers.

Morphological Characters.—Length 3 to 4 mm.; color brown to dark brown.

Dryocoetes betulae Hopkins

1894 *Dryocoetes eichhoffi,* Hopkins, Can. Ent. **26**:279
1909 *Dryocoetes eichhoffi,* Swaine, Cat. Scolytidae, p. 103
1915 *Dryocoetes betulae,* Hopkins, Classif. Cryphalinae, p. 50
1916 *Dryocoetes betulae,* Blatchley & Leng, Rhynch. N. E. Amer., p. 611
1918 *Dryocoetes betulae,* Swaine, Can. Bark Beetles, p. 131
1922 *Dryocoetes betulae,* Blackman, Miss. Bark Beetles, p. 120

This species breeds in birches and is known from Mississippi to Newfoundland and British Columbia. No Minnesota specimens have been seen.

Dryocoetes affaber (Mannerheim)

1852 *Bostrichus affaber,* Mannerheim, Bul. Moscou, p. 359(151)
1909 *Dryocoetes affaber,* Swaine, Cat. Scolytidae, p. 101
1915 *Dryocoetes piceae,* Hopkins, Classif. Cryphalinae, p. 51
1918 *Dryocoetes affaber* (= *piceae* Hopkins?), Swaine, Can. Bark Beetles p. 132

Specimens Examined.—Thirty-four, Lake County near Ely.

Host.—White spruce.

Morphological Characters.—Color brown; the female with a frontal area of denser, longer hairs. Our specimens are of the smaller eastern race, which was described as *Dryocoetes piceae* by Hopkins. A series of about 500 specimens vary from 2.1 to 2.7 mm. in length.

Biology.—This species was found in abundance breeding in the inner bark of white spruce. The burrows are radiate, with numerous egg galleries. The brood pupates in the inner bark and probably overwinters in the parent tree, for specimens taken September 14, 1936, include larvae, pupae, and adults.

Lymantor Lovendal

Lymantor decipiens (LeConte)

1878 *Xylocleptes decipiens,* LeConte, Proc. Amer. Phil. Soc. **17**:666
1909 *Xylocleptes decipiens,* Swaine, Cat. Scolytidae, p. 159
1916 *Lymantor decipiens,* Blatchley & Leng, Rhynch. N. E. Amer., p. 608
1918 *Lymantor decipiens,* Swaine, Can. Bark Beetles, p. 131
1922 *Lymantor decipiens,* Blackman, Miss. Bark Beetles, p. 121

This species is known from Mississippi, Michigan, and Canada, and may occur here. It breeds in the sapwood of dead and dry limbs, the recorded hosts being *Hicoria, Pyrus,* and *Acer.*

BIBLIOGRAPHY

Blackman, M. W. (1915) Observations on the Life History and Habits of *Pityogenes hopkinsi* Swaine. New York State Col. Forestry, Syracuse, Tech. Publ. No. 2, **16**(1):11-66.

———. (1919) Notes on Forest Insects; I, On Two Bark Beetles Attacking the Trunks of White Pine Trees. Psyche **26**:85-96, 1 pl.

———. (1920) North American Ipidae of the Subfamily Micracinae, with Descriptions of New Species and New Genera. Miss. Agr. Expt. Sta. Tech. Bull. No. 9, 58 pp., 5 pl.

———. (1921) Descriptions of Eight New Bark Beetles from Mississippi. Miss. Agr. Expt. Sta. Tech. Bull. No. 10, 16 pp.

———. (1922) Mississippi Bark Beetles. Miss. Agr. Expt. Sta. Tech. Bull. No. 11, 130 pp., 18 pl.

———. (1928) The Genus *Pityophthorus* in North America. Notes on Micracinae, with Descriptions of Twelve New Species. New York State Col. Forestry, Syracuse, Tech. Publ. No. 25, **1**(3b):1-212, 9 pl.

———. (1931) A Revisional Study of the Genus *Pseudopityophthorus* in North America. Jour. Wash. Acad. Sci. **21**:223-236.

———. (1934) A Revisional Study of the Genus *Scolytus* Geoffrey (*Eccoptogaster* Herbst) in North America. United States Dept. Agr. Tech. Bull. No. 431, 30 pp.

BLACKMAN, M. W., and STAGE, H. H. (1918) Notes on Insects Bred from the Bark and Wood of American Larch. New York State Col. Forestry, Syracuse, Tech. Publ. No. 10, 115 pp., illus.

———. (1924) On the Succession of Insects Living in the Bark and Wood of Dying, Dead and Decaying Hickory. New York State Col. Forestry Tech. Publ. No. 17, **24**(*22*) :1-240, 14 pl.

BLATCHLEY, W. S., and LENG, C. W. (1916) Rhynchophora of Northeastern America. Nature Publ. Co., Indianapolis, 682 pp.

CHAPUIS, F. (1873) Synopsis des Scolytides. Mem. Soc. Sci. Liege **3**:213-269.

EICHHOFF, W. (1867) Neue Amerikanische Borkankäfer—Gattung und Arten. Berlin. Ent. Zeit. **11**:399-402.

———. (1868) Neue Amerikanische Borkenkäfer—Gattung und Arten. Berlin. Ent. Zeit. **12**:145-152.

———. (1871) Neue exotische Tomiciden-Arten. Berlin. Ent. Zeit. **15**: 132-137.

ERICHSON, W. F. (1836) Systematische Auseinandersetzung der Familie der Borkenkäfer. Archiv. Naturgesch. **2**:45-65.

FELT, E. P. (1905-1906) Insects Affecting Park and Woodland Trees. New York State Museum 59th Annual Rept., 1905, Vol. 3-4, Appendix 7, (Museum Memoirs 8, Vols. 1 & 2) Albany, New York. 877 pp.

FITCH, ASA. (1856) Third Report on the Noxious and Other Insects of the State of New York. Trans. New York State Agr. Soc. **16**:315-490.

———. (1858) Fourth Report on the Noxious and Other Insects of the State of New York. New York State Agr. Soc. Annual Report, 1857, pp. 687-814.

GERMAR, E. F. (1824) Insectorum Species Novae, Halli, 624 pp., 2 pl.

GOSSARD, H. A. (1913) Orchard Bark Beetles and Pin Hole Borers. Ohio Agr. Expt. Sta. Bull. 264, 68 pp.

HARRIS, T. W. (1852) A Report on the Insects of Massachusetts Injurious to Vegetation, Second Edition, Boston, 513 pp.

HOPKINS, A. D.)1894) Sexual characters in Scolytidae. (A preliminary contribution.) Can. Ent. **26**:274-280.

———. (1901) Insect Enemies of the Spruce in the Northwest. United States Dept. Agr. Div. Ent. Bull. 28, new series, 48 pp., illus.

———. (1909a) The Genus *Dendroctonus*. United States Dept. Agr. Bur. Ent. Tech. Bull. No. 17, pt. 1, 164 pp., illus.

———. (1909b) Barkbeetles of the Genus *Dendroctonus*. United States Dept. Agr. Bur. Ent. Bull. No. 83, pt. 1, 169 pp., illus.

———. (1915a) New Scolytidae. Jour. Wash. Acad. Sci. **5**:429-433.

———. (1915b) Preliminary Classification of the Superfamily Scolytoidea. United States Dept. Agr. Bur. Ent. Tech. Ser. Bull. No. 17, pt. 2, pp. 165-232, 16 pl., figs.

———. (1915c) Classification of the Cryphaline, with Descriptions of New Genera and Species. United States Dept. Agr. Office of the Secretary, Rept. 99, 75 pp., 4 pl.

HUBBARD, H. G. (1897) The Ambrosia Beetles of the United States. United States Dept. Agr. Bur. Ent. Bull. 7, 30 pp.

KIRBY, WM. (1837) Fauna Boreali-Americana, Vol. 4: Insects, London, 325 pp., 8 pl.

LEACH, J. C., ORR, L. W., and CHRISTENSEN, C. (1935) The Interrelationships of Bark Beetles and Blue-staining Fungi in felled Norway Pine Timber. Jour. Agr. Res. **49**:315-341, 13 figs.

LECONTE, J. L. (1860) Reports of Explorations and Surveys from the Mississippi River to the Pacific Ocean. Pacific R. R. Explor. Vol. 12, bk. 2, pt. 3, pp. 1-72, 2 pl.

———. (1868) Synopsis of Scolytidae (Zimmerman, ed. by LeConte). Trans. Amer. Ent. Soc. **2**:141-178.

———. (1874) Descriptions of New Coleoptera chiefly from the Pacific Slope of North America. Trans. Amer. Ent. Soc. **5**:43-72.

———. (1876) Scolytidae in "Rhynchophora of America North of Mexico." Proc. Amer. Phil. Soc. **15**:341-390.

———. (1878) The Coleoptera of Michigan, by Hubbard and Schwarz, with Descriptions of New Species by J. L. LeConte. Proc. Amer. Phil. Soc. **17**:593-626.

LENG, C. W. (1920) Catalogue of the Coleoptera of America, North of Mexico. Mt. Vernon, New York, 470 pp.

MANNERHEIM, G. C. G. (1852) Zweiter Nachtrag zur Käferfauna der Nord-Amerikanischen Länder des Russischen Reiches. Bull. Moscou **25**:283-387.

———. (1853) Dritter Nachtrag der Aleutischen Insecten. Bull. Moscou **26**:95-273.

RATZEBURG, J. T. C. (1839) Die Forst-insekten, Vol. 1, pt. 2, Die Käfer. Berlin, 247 pp.

RILEY, C. V. (1867) Hickory Bark Borer. Prairie Farmer **19**:68-69.

ROCKWOOD, L. P. (1926) The Clover Root Borer. United States Dept. Agr. Dept. Bull. 1426, 48 pp., 16 figs.

SAY, THOMAS. (1823-1825) Descriptions of Coleopterous Insects Collected in the Late Expedition to the Rocky Mountains, Performed by Order of Mr. Calhoun, Secretary of War, under the Command of Major Long. Jour. Acad. Nat. Sci. Phila. **3**:139-216; 238-282; 298-331; 402-462. **4**:88-99.

———. (1825-1826) Descriptions of New Coleopterous Insects Inhabiting the United States. Jour. Acad. Nat. Sci. Phila. **5**:160-204; 237-284; 293-304.

SCHWARZ, E. A. (1895) Description of the pine cone inhabiting Scolytid. Proc. Ent. Soc. Wash. **3**:143-145.

SIMPSON, L. J. (1929) The Seasonal History of *Polygraphus rufipennis* Kirby. Can. Ent. **61**:146-151.

SWAINE, J. M. (1909) Catalogue of the Described Scolytidae of America North of Mexico. New York State Museum Bull. 134, pp. 76-159, 17 pl.

———. (1910) A New Species of *Eccoptogaster*. Can. Ent. **42**:33-35, 1 pl.

———. (1911) A Few New Ipidae. Can. Ent. **43**:213-224.

———. (1912) New Species of the Family Ipidae. Can. Ent. **44**:349-353.

———. (1915a) Descriptions of New Species of Ipidae. Can. Ent. **47**:355-369.

———. (1915b) A New Species of *Pityogenes*. New York State Col. Forestry, Syracuse, Tech. Publ. No. 2, **16**(1):8-10.

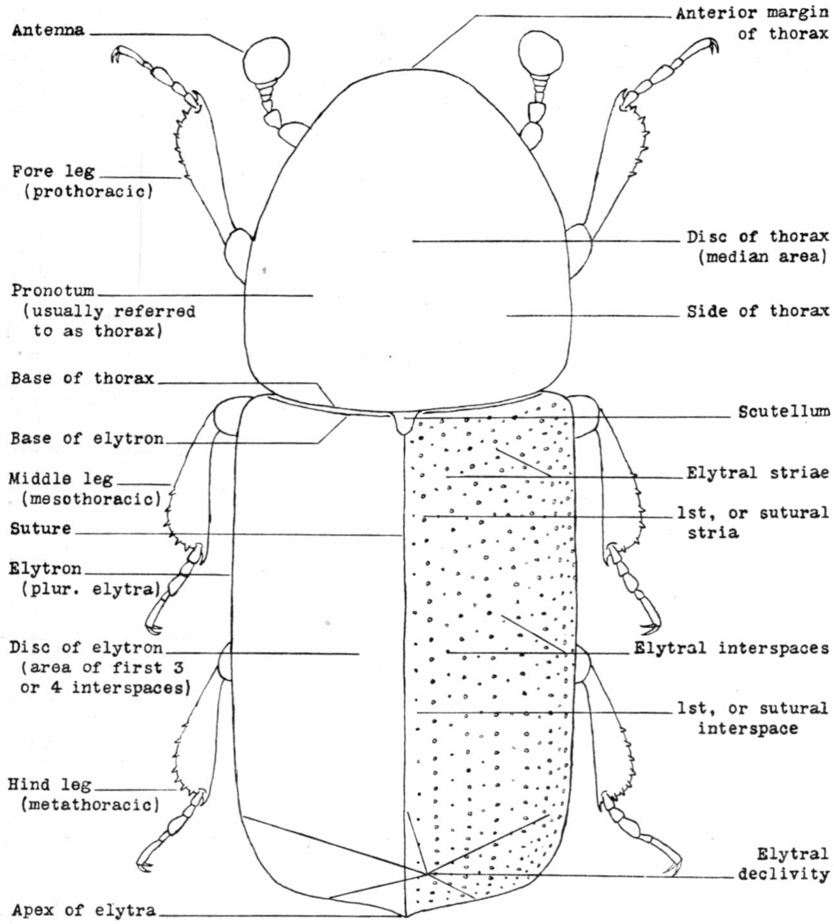
———. (1916) New Species of the Family Ipidae, pt. 3, Can. Ent. **48**:181-192.

———. (1917) Canadian Bark Beetles, pt. 1, Can. Dept. Agr. Ent. Branch, Bull. (Tech. Bull.) 14, 32 pp.

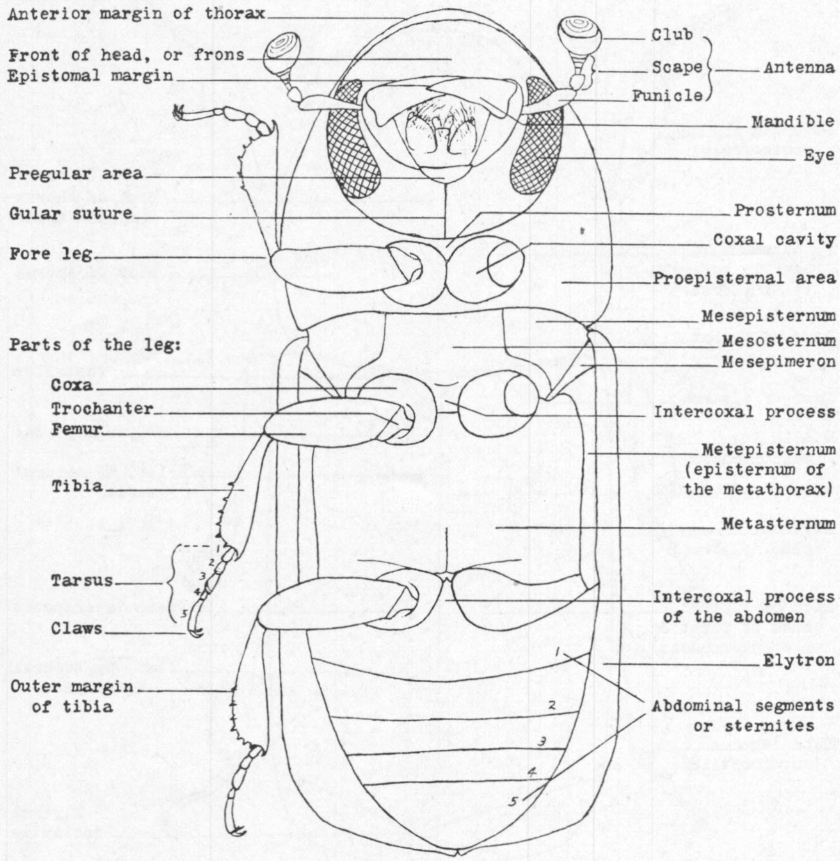
———. (1918) Canadian Bark Beetles, pt. 2. Can. Dept. Agr. Ent. Branch, Bull. (Tech. Bull.) 14, 143 pp., illus.

WATSON, E. B. (1931) The Seasonal History of *Dendroctonus rufipennis* in Northern Ontario. Can. Ent. **63**:126-127.

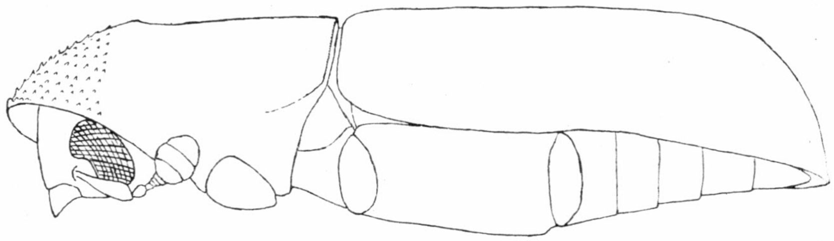
ZIMMERMAN, C. (1868) Synopsis of the Scolytidae of America North of Mexico. Trans. Amer. Ent. Soc. **2**:141-149.



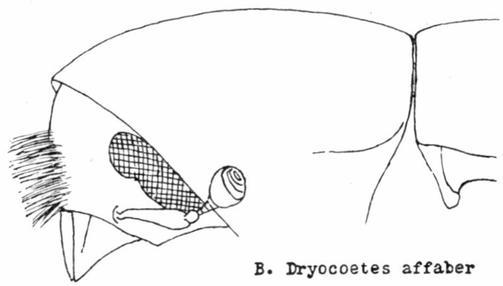
Dorsal view of Dryocoetes affaber.



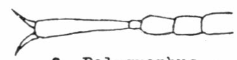
Ventral view of Dryocoetes affaber.



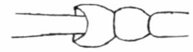
A. Gnathotrichus materiarius



B. Dryocoetes affaber

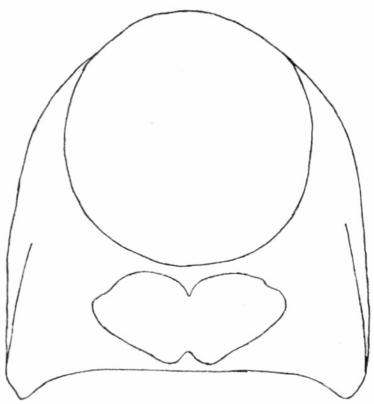


C. Polygraphus rufipennis

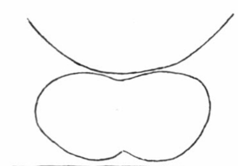


D. Hylastes porculus

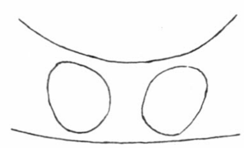
E. Hylurgops pinifex



F. Ips pini

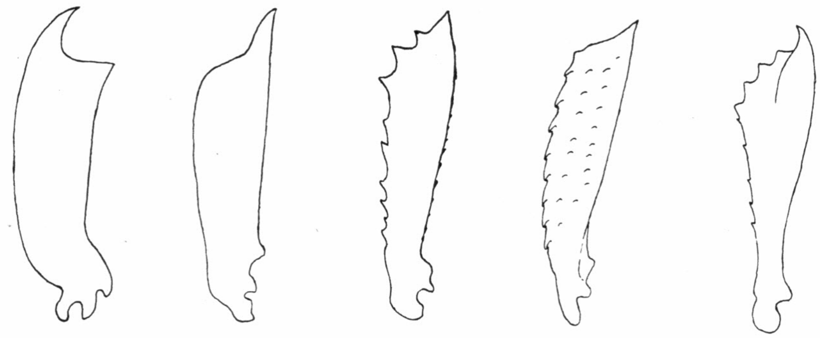


G. Pityogenes hopkinsi

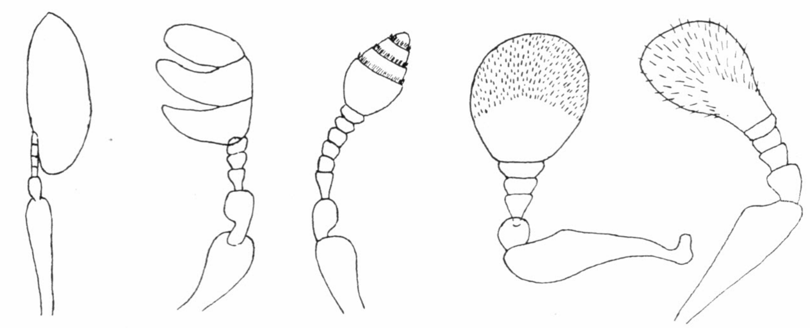


H. Hylurgopinus rufipes

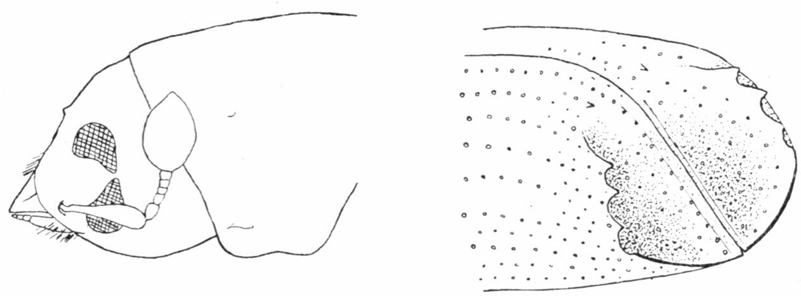
Fig. A. Lateral view of Gnathotrichus materiarius. Fig B. Lateral view of anterior portion of Dryocoetes affaber, female. Fig. C. Dorsal view of tarsus of Polygraphus rufipennis. Fig. D. Dorsal view of fore tarsus of Hylastes porculus. Fig. E. Dorsal view of fore tarsus of Hylurgops pinifex. Fig. F. Ventral view of the prothorax of Ips pini, showing the nature of the coxal cavities and prosternum. Fig. G. Prosternal region of Pityogenes hopkinsi. Fig. H. Prosternal region of Hylurgopinus rufipes.



A. Scolytus piceae B. Micracis opacicollis C. Ips pini D. Monarthrum mali E. Anisandrus obesus



F. Chramesus hicoriae G. Phthorophloeus dentifrons H. Hylurgops pinifex I. Xyloterinus politus J. Trypodendron retusum



K. Polygraphus rufipennis L. Ips pini

Fig. A. Anterior tibia of Scolytus piceae, dorsal face of left tibia. Fig. B. Anterior tibia of Micracis opacicollis, dorsal face of left tibia. Fig. C. Anterior tibia of Ips pini, dorsal face of left tibia. Fig. D. Ventral face of right anterior tibia of Monarthrum mali. Fig. E. Dorsal face of left anterior tibia of Anisandrus obesus. Fig. F. Antenna of Chramesus hicoriae. Fig. G. Antenna of Phthorophloeus dentifrons. Fig. H. Antenna of Hylurgops pinifex. Fig. I. Antenna of Xyloterinus politus. Fig. J. Antenna of Trypodendron retusum. Fig. K. Lateral view of head and thorax of Polygraphus rufipennis. Fig. L. Postero-lateral view of elytra of Ips pini, showing the concave declivity bordered by lateral teeth and a subapical produced plate.

INDEX TO SPECIES

(Synonyms are in Italics)