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BARK BEETLES OF THE GENUS DRYOCOETES
(COLEOPTERA: SCOLYTIDAE) IN NORTH AMERICA

A THESIS
SUBMITTED TO
THE DEPARTMENT OF ZOOLOGY AND ENTOMOLOGY
BRIGHAM YOUNG UNIVERSITY

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF
MASTER OF SCIENCE

BY
DONALD EDWARD BRIGHT, JR.

JUNE, 1961

This Thesis by Donald Edward Bright, Jr. is accepted in its present form by the Department of Zoology and Entomology of Brigham Young University as satisfying the Thesis requirement for the degree of Master of Science.

June, 1961

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INTRODUCTION

The genus Dryocoetes is widely distributed in Europe, Asia, North America and Central America. It consists of about sixty species, seven of which occur in North America.

All seven species in North America bore in ^{the} bark of the host tree where they feed and reproduce in the phloem layer. Usually they are found in the larger part of the bole or near the ground line feeding in roots. The species generally are host specific, limiting their attacks to two or three genera of trees. Only one North American species, betulae, attacks broadleaf trees; the remainder feed in coniferous trees, usually Picea or Abies. Since these insects feed for the most part in dying or injured trees and windfalls, direct economic loss is generally nil. However, confusus may attack and kill apparently healthy trees.

As far as known all species in the genus are polygamous, ordinarily with about three or four females associated with one male. Apparently, the male begins the entrance tunnel and hollows out the nuptial chamber where he waits for the females. In the cambial layer, each female constructs an egg gallery that radiates from the nuptial chamber. Eggs are laid along the gallery in niches and then covered with frass. The female pushes her excess boring dust toward the entrance where it is expelled by the male.

Mathers (1931) states, in the case of confusus, that the adults

emerge from hibernation in the latter part of June and fly until late July. Soon after emerging, they attack new trees where they excavate the first brood tunnels. Eggs are laid in these tunnels until late August, the beginning of cold weather, when the adults excavate feeding and hibernating tunnels. The male gallery extends from the nuptial chamber and the female continues the egg tunnel, these portions being recognized by the absence of egg niches. The parent adults pass the winter in these galleries. At the beginning of warm weather in the spring, the female beetles continue their galleries, laying eggs in the freshly cut portions. Egg laying continues until late June or early July, after which the parent adults may emerge and attack a new tree or they may die in the galleries. The first brood of eggs hatch by late August and pass the winter as young larvae. Pupae of this brood are present in late July or early August of the following year and transform to adults in late August. These young adults remain in the trees until spring, thus giving a life cycle of two years.

The two year life cycle described above is probably true only in the northern portion of the range of confusus. In the western and southwestern United States, the life cycle evidently may be completed in one year or less.

The tribe Dryocoetini is large and complex. Its systematics cannot be adequately understood until all included genera are redefined and revised. The present study, although limited to North America, is a contribution to our knowledge of Dryocoetes Eichhoff, the largest genus in this group. It was undertaken because no revisional study is available to assist in the identification of North American species.

HISTORY

The genus Dryocoetes was described by Eichhoff (1864, p. 38) to include four European species: Bostrichus autographus Ratzeburg, B. cryptographus Ratzeburg, B. dactyliperda Fabricius, and B. villosus Fabricius. Of these, B. cryptographus was transferred to Xyleborus by Eichhoff (1881, p. 276), and B. dactyliperda was made the type of Coccotrypes also by Eichhoff (1879, p. 309). Eichhoff (1864, p. 38) further stated that probably B. alni George. and apparently B. bicolor Herbst (transferred to Taphrorychus, Eichhoff (1879, p. 205)) should be included in Dryocoetes. Since then, numerous species from North America, Central America and Eurasia have been described.

In the only other division of the genus, Balachowsky (1949, p. 178) erected the genus Dryocoetinus for alni and villosus, based on the almost totally granulate pronotum, with punctures on the anterior portion of the disk, and the deeply impressed sutural interspace at the apical portion of the declivity of these species. This new division has not been accepted by later workers, and Schedl (date unavailable) placed this genus in synonymy.

The first North American species of Dryocoetes was described as Bostrichus septentrionis by Mannerheim (1843, p. 298). In 1852, Mannerheim described a second species, affaber (p. 359), also in the genus Bostrichus, and Leconte (1868, p. 162) a third, granicollis as a Xyleborus. The remaining North American species were described as

Dryocoetes by Hopkins and Swaine. In 1912, Swaine described pubescens (p. 350) and confusus (p. 351); in 1915, sechelti (p. 350) and pseudotsugae (p. 360) were described. Hopkins, in 1915a, described betulae (p. 50), caryi (p. 50), americanus (p. 51), liquidambaris (p. 51) and piceae (p. 51).

METHODS

Approximately four thousand specimens of Dryocoetes were examined during this study, including the allotype of caryi and one broken paratype of sechelti. Of the remaining species, specimens of betulae, piceae, and confusus which bore the same data as the type, but not designated as paratypes, were seen. Specimens of americanus determined by Hopkins and specimens of affaber, granicollis and pubescens determined by Blackman were examined. The identification of septentrionis is based on a specimen in the collection of S. L. Wood which had been compared by him to the Mannerheim specimen in the Canadian National Collection.

After dissecting the male genitalic capsule from a specimen, the capsule was placed in a cold five per cent potassium hydroxide solution until the muscle fiber had dissolved away. The capsule was then washed in water several times, and transferred to microvials containing glycerine. The dissected specimen was remounted and the vial containing its genitalia was placed on the pin for future reference. A minimum of two to four specimens per species were used for each of the above dissections.

Illustrations were prepared with the aid of an ocular grid. The antennal drawing was made from a Canada balsam slide preparation; those of the male genitalia were made while the genital capsule was immersed in glycerine; and pinned specimens were used for drawings of the pronotums.

Measurements were made by using a calibrated ocular grid. These

measurements represent the averages of many measurements and should be used with caution since some specimens may not fall in the size range that is stated.

INTRASPECIFIC VARIATION

Sexual Variation

Sexual variation was observed in all species of North American Dryocoetes. In the small species, sechelti, caryi and granicolis, the differences are slight and very difficult to detect. Generally, the female has more hair-like pubescence on the frons and somewhat larger granules on the elytral declivity.

The most striking sexual variation in this genus occurs in confusus, where the female frons is very densely, closely hairy with the short setae longer at the periphery. The male frons is convex, granulate-punctate and only sparsely hairy. The sutural interspace of the elytral declivity is more strongly elevated and more coarsely granulate in the female.

In the other large species, the frons of the female is flattened or slightly concave and usually more or less densely clothed with hairs, whereas that of the male is convex or smooth and punctured and only sparsely hairy.

Individual Variation

Variation in body length was noted in all species, but is prominent only in two. The difference in length between the largest and smallest specimens equalled about thirty percent of the smallest. Environmental factors evidently influence the size of the individuals, since host conditions, such as moisture content and temperature are important agents.

Body color generally is consistent throughout the genus, varying from reddish-brown to almost black. The immature specimens are lighter in color, and gradually acquire the mature, darker color.

The surface of the pronotum often exhibits differences between individuals of the same series. Certain specimens of autographus have the smooth median line obscured by punctures and asperities. Other specimens may show a difference in the size and abundance of punctures. The pronotal shape may also show a slight variation. For example, in most specimens of affaber the pronotum is triangular (Fig. 2), but occasionally it may be more rounded, with the widest part more toward the middle. In individuals of all species, variations in placement and depth of punctures, and in size and surface sculpture of asperities may be found.

The elytral disk and declivity also show slight variation within a series. No one species can be singled out for discussion, since the variations are observed in all species. The most prominent individual difference occurs in the size, depth and distribution of the punctures on the elytral disk and in the degree of elevation of the sutural striae on the declivity. Other characters that may vary are the amount and length of pubescence, the abundance of interstitial punctures and the size of the granules of the declivity.

Geographical Variation

Geographical variation was noted especially in the size of specimens of affaber and autographus from different areas of their ranges (Charts 1 and 2). These species exhibited a gradual increase in size from the eastern and southeastern portions of their ranges to the north-

western and northern parts. The largest average size of both species is reached between Oregon and Alaska.

Locality	Number of Specimens	Size in mm.		
		Maximum	Minimum	Average
Maine	10	2.60	2.30	2.45
Michigan and Minnesota	10	2.75	2.35	2.58
Colorado	10	2.80	2.40	2.50
Utah	10	2.85	2.50	2.74
Oregon	10	3.00	2.25	2.70
British Columbia	10	3.50	2.50	2.88
Juneau, Alaska (near type locality)	10	3.25	2.70	3.10

Chart 1. Variations in size of Dryocoetes affaber.

Locality	Number of Specimens	Size in mm.		
		Maximum	Minimum	Average
Maine	10	3.80	3.10	3.40
Quebec	10	4.00	3.10	3.53
Michigan and Minnesota	10	4.20	3.25	3.70
Northwest Territory	10	4.15	3.50	3.81
Alberta	10	4.25	3.50	3.85
Juneau, Alaska (near type locality)	10	4.75	3.75	4.25
England	10	4.00	3.25	3.65

Chart 2. Variations in size of Dryocoetes autographus.

The charts on the preceding page show the range in size of series from various localities and illustrates the gradual increase in size from southeastern to northwestern areas. A series of autographus from Europe is included in Chart 2 to show the size of specimens from that area.

In the eastern part of its range, the declivital punctures of affaber are somewhat smaller than those from the west. On some individuals of this species from Colorado and Utah, the declivital punctures are larger and more coarse; this can also be seen on specimens from all parts of its range. This variation evidently is somewhat common in the intermountain region, more so than in other areas. The size of the declivital granules also varies from east to west; those with smaller granules being more common in the east.

Specimens of autographus from the eastern portion of its range also have smaller declivital granules, and somewhat smaller elytral punctures.

In specimens of confusus from Arizona, the sutural striae are comparatively more strongly elevated than in specimens from farther north.

DISCUSSION OF CHARACTERS

The classification of the genus Dryocoetes in North America was formerly based by Swaine (1918) on size, locality and host; morphology being used to indicate species groups. A thorough analysis of all the characters useful in the classification of the family Scolytidae is not available nor have all the possible characters been investigated. The most useful characters used in this study are briefly discussed.

The genus Dryocoetes belongs in the tribe Dryocoetini in the subfamily Ipinae. Other related genera in this tribe include Taphrorychus Eichhoff (Europe), Crytogenius Strohmeier (Africa), Ozopemon Hagedorn (southeast Asia), and Carposinus Hopkins (southeast Asia). These genera are distinguished from all other scolytid genera by the evenly convex pronotum; by the obliquely truncate antennal club (or possessing a club derived from that type); by the flattened, spinose distal portion of the tibiae and by the convex or flattened, unarmed, granulate declivity.

These genera may be distinguished from one another by several characters, the most important of which are the characters of the antennal club. In Taphrorychus, the antennal club is circular, with the thickened basal area occupying less than one-fourth the total length and margined distally by a recurved line, the female frons is concave with a dense pile of short hairs and the declivity is convex with the sutural striae more strongly convex. Crytogenius may be distinguished by the circular club, as in Taphrorychus, but the club has no basal corneous

area. It may also be distinguished by the four-segmented antennal funicle, by the impressed elytral striae and by the scutellum being wider than long. In Ozopemon, the club is more pointed at the distal end, the corneous basal portion occupying less than half the total length, with the first suture indicated by a scleritized procurved line; the pronotum is much wider than long, with a distinct summit and acute asperities; the scutellum is V-shaped. Carposinus is distinguished by the sub-truncate, circular antennal club; by the impressed elytral striae; by the indefinite pronotal summit and by the V-shaped scutellum.

Frons

The pubescence of the frons of the female is extremely valuable in the classification of the genus. It varies from densely clothed, completely hiding the surface of the frons in confusus, to only sparsely clothed in autographus. The surface may be smooth and minutely granulate, as in granicollis, to moderately roughened, as in autographus.

In the male, frontal variations are less obvious, but nevertheless are present. For example, the frons is distinctly punctured and smooth in sechelti but roughly granulate-punctate in confusus and, to a lesser extent, in affaber. Pubescence of the male frons varies but little.

Antenna (Fig. 4)

The antennal scape is slightly longer than the funicle, slender, and widened at the distal end. The funicle is five-segmented, longer than the club, with the pedicle enlarged and cup-shaped, with segments two to five smaller and gradually increasing in size distally. The club

is obliquely truncate with the truncate portion occupying less than half the club in all species. The shape varies from sub-oval, approximately 1.4 times wider than long in autographus, to slightly longer than wide in affaber. The distal pubescent portion of the club projects beyond the corneous apex on the posterior face in autographus, betulae and granicollis. In the other species, no pubescence can be seen projecting beyond the apex. This character was not included in the key, since many specimens have the antennae lying close to the body, making observation of this character impossible.

Pronotum

The shape of the pronotum varies from somewhat triangular in caryi, sechelti and affaber (Fig. 2), to more nearly circular in betulae, confusus and autographus (Fig. 3), and elongate with parallel sides in granicollis (Fig. 1). In autographus, the surface of the pronotum is closely, densely punctured over the posterior two-thirds, the punctures being obscured, but still visible, by small asperities on the anterior portion. The surface of the pronotum in affaber is asperate over the entire surface tending to become granulate on the posterior one-fourth. In some specimens of affaber, a few small obscure punctures may be seen. The pronotal surface of granicollis is also asperate with a few shallow punctures.

Elytra

The sutural striae on the elytral disk may be impressed as in granicollis, or unimpressed as in affaber. The striae are regularly punctured in rows, varying greatly in depth and size between individuals.

The interspaces are smooth and minutely punctured in all species, except granicollis where they are roughened by the large, impressed stria punctures.

As in many scolytids, the declivity offers excellent characters. In granicollis, the sutural striae are deeply impressed making the suture strongly and prominently elevated, and the striae are deeply punctured. In confusus and betulae, the sutural striae are much less impressed and the suture is only moderately elevated. The remaining species have the sutural striae very slightly impressed, if at all and a feebly elevated suture.

Tibiae

The tibiae are slightly curved, widened at the distal end, abruptly truncate, and margined by from five to seven teeth. The number of teeth varies between individuals and even may vary in the same specimen. For this reason, the tibiae were of no value in the classification of the genus.

Male Genitalia

Excellent characters were found on the endophallie portion of the male genitalia (figs. 5-11). This structure varies from a large, flat, sac-like form, as in autographus, confusus, betulae and affaber, to moderately lobed in caryi and sechelti and deeply lobed in granicollis. The remainder of the genitalic capsule displays no characters useful in the determination of species. For this reason, the various structures are not named and no attempt is made in this study to homologize the structures with those of other species.

PHYLOGENY

Since the present study only includes a small fraction of the species of the genus Dryocoetes, a thorough discussion of the phylogeny of the group is not possible. A few general statements can be made, however.

Sexual dimorphism of the same general type is present to varying degrees in all the genera related to Dryocoetes. Any extreme development of these characters may be considered a specialization since they do not occur generally in other scolytids. The larviform male of Ozopemon browni, (Browne, 1957), is certainly a specialization. The reduction in number and size of stria and interstria punctures and the reduction in number of pronotal asperities in Ozopemon are other specialized characters. Since reduction in number or size of parts is indicative of specialization, the four-segmented antennal funicle of Cryptogenius may be considered specialized. The antennal club of related genera is obliquely truncate, except in Cryptogenius, where the club has no basal corneous portion and is not obliquely truncate.

From the above line of reasoning, it is thought that Ozopemon and Cryptogenius represent the more specialized genera in this discussion. Dryocoetes, because of the low degree of sexual dimorphism (except in three species), its obliquely truncate antennal club, moderate to large stria punctures and only a slight reduction in number of tibial spines, is considered to be a comparatively unspecialized genus.

These genera appear to have evolved from a common ancestral stock .

which probably had its center of distribution in Eurasia. In order to determine this hypothetical parent, approximately fifteen species in the five genera mentioned above were studied and analyzed. The author's concept of the hypothetical ancestor is most nearly fulfilled in the genus Dolurgus, which some authors place in the Dryocoetini. Dolurgus superficially resembles Dryocoetes and shows many of the same characters in a more primitive form. Sexual dimorphism is not evident, the antennal club shows a primitive obliquely truncate form, pronotal asperities are not developed and the anterior tibiae have six or more spines.

Among North American Dryocoetes, two lines of specialization are apparent. Along one line, the extreme advanced characters are the deeply impressed sutural striae of the declivity, the enlarged pronotum with parallel sides and the peculiar male genitalia shown by granicollis. Along the same line but less specialized are caryi and sechelti. The second line of specialization is illustrated by the sexual dimorphism, the reduced elytral punctures and the host specificity of betulae and confusus. The least specialized characters such as a convex, not impressed declivity, low degree of sexual dimorphism and unspecialized male genitalia are found in autographus. The position of affaber is uncertain, but it appears to be intermediate between the betulae-confusus group and autographus.

The above discussion, unfortunately, must be largely speculation. Since the tribe Dryocoetini is very large and occurs throughout the world, a thorough consideration of phylogeny is impossible at this time.

SYSTEMATIC SECTION

Genus Dryocoetes Eichhoff

yocoetes Eichhoff, 1864, Berliner Ent. Zeitschr., 8: 38; _____, 1879, Roy. soc. sci. Liège, Mem., Série 2, 8: 283; _____, 1881, Die europäischen Borkenkäfer, p. 261; Leconte, 1876, Amer. Philos. Soc., Proc. 15: 358; Provancher, 1877, Petite Faune Entomologique du Canada, 1: 568; Bedel, 1888, Annales de la Societe Entomologique de France, 6: 396, 400; Judeich and Nitsche, 1895, Lehrbuch der mitteleuropäischen Forstinsektenkunde 1: 449; Blandford, 1898, Biol. Centrali-Americana, Coleoptera 4(6): 186, 189; Barbey, 1901, Les Scolytides de l'Europe centrale, p. 100; Felt, 1906, New York St. Mus. Mem. 8(2): 337; Tredl, 1907, Entomologische Blätter, 3: 17; Swaine, 1909, New York St. Mus., Bull. 134, In Rept. of St. Ent. for 1908, Appendix B, p. 101; Hagedorn, 1910, Coleopterorum Catalogus, 4: 65; Reitter, 1913, Wiener Ent. Zeitschr. 32: 75; Hopkins, 1914, U. S. Nat. Mus., Proc. 48: 121; Blatchley and Leng, 1916, Rhynchopora of North Eastern America, p. 610; Swaine, 1918, Dom. Canada Dept. Agric. Ent. Branch, Tech. Bull. 14(2): 128; Blackman, 1922, Mississippi Agric. Expt. Sta., Tech. Bull. 11: 120; Dodge, 1938, Univ. Minnesota Agric. Expt. Sta., Tech. Bull. 132: 54; Chamberlin, 1939, The Bark and Timber Beetles of North America, p. 462; Beal and Massey, 1945, Duke Univ. School of Forest., Bull. 10: 159; Balachowsky, 1949, Fauna de France 50: 177; Stark, 1952,

Fauna U. S. S. R. 31: 323; Chamberlin, 1958, Scolytidae of the Northwest, p. 188.

Dryocoetinus Balachowsky, 1949, Fauna de France 50: 188.

This genus is distinguished from related genera by the granulate to punctate, evenly convex pronotum, with low, indistinct asperities; by the obliquely truncate antennal club with the basal portion reaching beyond the middle in the central area; by the short, steep, unarmed, granulate declivity; by the scutellum being longer than wide and by the rather slender, flattened, armed tibiae.

Description.— Body cylindrical, 2.0 - 4.8 mm. Color of mature specimens black to reddish-brown.

Frons convex, granulate over much of the surface and often densely hairy in the female. Antennal scape but little longer than funicle, widened on distal half; funicle five-segmented, pedicle larger and cup-shaped, segments two to five smaller, gradually increasing in size toward the club; club obliquely truncate with one or two recurved sutures on the pubescent anterior face, basal corneous portion occupying more than half the total length.

Pronotum evenly convex with anterior margin unarmed; dorsal surface usually granulate to finely asperate, more strongly in anterior portion, sometimes punctured in posterior portion. Scutellum longer than wide.

Elytra with striae feebly or not impressed, striae punctures large, usually impressed in regular rows; interspaces slightly wider than striae, smooth; interstriae punctures much smaller and somewhat more abundant than those of the striae, armed with long hair-like setae. Declivity steep, convex or flattened, unarmed; sutural striae impressed;

interspaces feebly granulate.

Middle and hind tibiae rather slender, somewhat flattened distally, truncate at distal end, armed with three to seven teeth (variable within individuals).

Vestiture abundant, hair-like.

Type species.-- Bostrichus autographus Ratzeburg, subsequent designation by Hopkins (1914: 121).

Key to North American species of Dryocoetes.

1. Pronotum widest at or near the middle, sides rather strongly arcuate (Fig. 3); proepimeron usually with large, shallow punctures; larger species, usually over 3 mm. _____ 2
- Pronotum widest at base or sides parallel, sides weakly arcuate (Figs. 1 and 2); proepimeron indistinctly if at all punctured except in a few affaber; smaller species, usually under 3 mm. ____ 4
2. Female frons with a dense brush of short, yellowish, hair-like setae; declivity of both sexes steep, flattened, with sutural interspace distinctly, sometimes slightly, elevated; disk of pronotum finely densely asperate. _____ 3
- Female frons with sparsely placed hair-like setae, granulate-punctate with an impunctate smooth median space; male frons more sparsely clothed with setae and distinctly granulate; declivity evenly convex, not steep, with sutural interspace feebly raised; disk of pronotum distinctly punctured with an impunctate or slightly raised median line, asperities small and low on anterior and lateral portions. _____ autographus (Ratzeburg)
3. Female frons very densely clothed by hair-like setae, concealing the surface of the frons, setae shorter in center, longer and incurved at periphery; pronotum finely asperate over entire surface,

clothed by long, yellow setae; declivity flattened with sutural interspace distinctly raised; from Abies. _____ confusus Swaine

- Female frons less densely hairy, not concealing the surface of the frons; disk of pronotum sparsely punctured in median area of posterior half, distinctly asperate on lateral and anterior portions; interspaces of declivity less strongly impressed than confusus; from Betula and Pyrus. _____ betulae Hopkins

4. Declivity with the sutural striae deeply impressed, the punctures large, deep; sutural interspace strongly elevated with median row of granules; pronotum about 1.3 times as long as wide, the sides subparallel on posterior two-thirds; elytral punctures large, close and deep; interspaces narrow on disk, wider on declivity. _____ granicollis (Leconte)

- Declivity with sutural striae feebly if at all impressed; sutural interspace slightly raised; pronotum less than 1.2 times as long as wide, widest behind middle; elytral punctures smaller, slightly impressed; interspaces as wide or wider than striae on disk and declivity. _____ 5

5. Female frons closely pubescent, setae long and uneven, those on upper margin longer and incurved; male frons with fewer setae; declivity more strongly flattened, with first and second striae slightly impressed; pronotum less strongly convex; larger, 2.6 - 3.2 mm.; in Picea. _____ affaber (Mannerheim)

- Female frons only slightly more pubescent than male; declivity

evenly convex; pronotum strongly convex, disk appearing granulate;
smaller, 1.5 - 2.5 mm. _____ 6

Sutural striae very slightly impressed, the punctures on declivity
reduced in size or indistinct; frons granulate-punctate with
slightly raised, impunctate, longitudinal median line; in Abies _____
_____ sechelti Swaine

Sutural striae distinctly impressed, their punctures not reduced on
declivity; median line of frons wider and more distinctly raised;
in Picea. _____ caryi Hopkins

Dryocoetes autographus (Ratzeburg)

Bostrichus autographus Ratzeburg, 1837, Die Forst-insecten 1: 160.

Dryocoetes autographus, Eichhoff, 1864, Berliner Ent. Zeitschr. 8: 39;

Ferrari, 1867, Borkenkäfer, p. 27; Eichhoff, 1879, Roy. sci. soc.

Liège, Mem., Série 2, 8: 284; _____, 1881, Die europäischen

Borkenkäfer, p. 261; Bedel, 1888, Annales de la Societe

Entomologique de France 6: 400; Hamilton, 1890, Ent. Americana 6:

44; Hopkins, 1894, Canadian Ent. 26: 279; Smith, 1900, Catalog

Ins. New Jersey, p. 363; Barbey, 1901, Les Scolytides de l'Europe

central, p. 101; Felt, 1906, New York St. Mus. Mem. 8(2): 672;

Tredl, 1907, Ent. Blatt. 3: 17; Niisima, 1909, Tohoku Imperial

Univ., Jour. 3(2): 151; Reitter, 1913, Wiener Ent. Zeitschr. 32:

76; Spessivtseff, 1928, Meddel. fran Statens Skogsforsoksanstalt

24(8): 235; Balachowsky, 1949, Fauna de France 50: 178; Stark,

1952, Fauna U. S. S. R. 31: 336.

Bostrichus septentrionis Mannerheim, 1843, Bull. Naturforsch. Gesellsch.

Moskau 16: 126.

Xyleborus septentrionis, Leconte, 1868, American Ent. Soc., Trans. 2: 161.

Dryocoetes septentrionis, Leconte, 1876, American Philos. Soc., Proc. 15:

361; Provancher, 1877, Petite Faune Entomologique du Canada 1: 568;

Hubbard and Schwarz, 1878, American Philos. Soc., Proc. 17: 643;

Eichhoff, 1879, Roy. sci. soc. Liège, Mem., Série 2, 8: 284; _____,

1881, Die europäischen Borkenkäfer, p. 262; Schwarz, 1886, Ent.

Americana 2: 42; Bedel, 1888, Annales de la Societe Entomologique de France 6: 416; Hamilton, 1889, American Ent. Soc., Trans. 16: 159; Hopkins, 1893, West Virginia Agric. Expt. Sta., Bull. 31: 137; Fall and Cockerell, 1907, American Ent. Soc., Trans. 33: 217; Swaine, 1909, New York St. Mus. Bull. 134. In Report of St. Ent. for 1908, Appendix B, p. 102; Hagedorn, 1910, Coleopterum Catalogus 4: 66; Swaine, 1918, Dom. Canada Dept. Agric. Ent. Branch, Tech. Bull. 14(2): 131; Chamberlin, 1939, The Bark and Timber Beetles of North America, p. 466; _____, 1958, Scolytidae of the Northwest, p. 110.

Bostrichus semicastaneus Mannerheim, 1852, Bull. Soc. Imp. Nat. Moscow 2: 77.

Dryocoetes americanus Hopkins, 1915, U. S. Dept. Agric. Rept. 99, p. 51; Blatchley and Leng, 1916, Rhynchopora of North Eastern America, p. 612; Blackman and Stage, 1918, New York St. College of Forest., Tech. Pub. 10, p. 59; Swaine, 1918, Dom. Canada Dept. Agric. Ent. Branch, Tech. Bull. 14(2): 132; Blackman, 1919, Phyche 26: 90; Felt, 1924, Manual Tree Ins., p. 271; Dodge, 1938, Univ. Minnesota Agric. Expt. Sta., Tech. Bull. 132: 55; Chamberlin, 1939, The Bark and Timber Beetles of North America, p. 466.

Dryocoetes pseudotsugae Swaine, 1915, Canadian Ent. 47: 360; _____, 1918, Dom. Canada Dept. Agric. Ent. Branch, Tech. Bull. 14(2): 130; Keen, 1936, U. S. Dept. Agric., Misc. Pub. 273: 125; Chamberlin, 1939, The Bark and Timber Beetles of North America, p. 465; _____, 1958, Scolytidae of the Northwest, p. 190.

This species is distinguished from all other North American Dryocoetes by the distinctly punctured pronotal disk, by the convex

declivity with the sutural interspace only slightly raised, and by the absence of a dense mat of hair on the female frons.

Female.-- Length 3.4 - 5.0 mm. Mature color reddish-brown to black.

Frons broad, strongly convex, flattened just above the epistomal margin; surface granulate-punctate, clothed with a few long yellow hairs, with impunctate median smooth space about the size of, or smaller than, antennal club. Antennal club as long as wide, basal corneous portion occupying half the total length. Eyes coarsely granulate and shallowly emarginate.

Pronotum as wide as long, widest at or near middle, sides strongly arcuate and anterior margin broadly rounded; lateral areas and anterior third roughened by small, low confused asperities, disk strongly punctured with median line impunctate or slightly raised. Pubescence consisting of moderately abundant long yellow hair.

Elytra 1.7 times as long as wide; sides parallel, posterior outline broadly rounded; striae punctures large, deep and in regular rows; interstriae usually as wide as striae, punctures as numerous as striae except on declivity, and much smaller, each armed by a moderately long yellow hair-like seta about as long as width of an interspace. Declivity convex, first and third interspaces slightly elevated, second interspace flattened, slightly depressed; interspaces with a median row of small granules armed by moderately long yellow hair.

Male.-- Similar to female except frons more sparsely hairy, somewhat broader; declivity more strongly flattened with sutural and third interspaces less elevated; the interstitial granules much reduced or obsolete. Male genitalia as illustrated (Fig. 11).

Type Locality.— Europe, exact locality not know.

Hosts.— Picea, Tsuga and Pseudotsuga, also recorded from Abies frazeri, Liriodendron tulipifera and Pinus spp.

Distribution.— Throughout the coniferous forests of Europe and Asia and in North America north of North Carolina and New Mexico.

Specimens examined from: Alaska: Anchorage, Chichagof Island, Eagle, Juneau, Kasilof, Ketchikan, Matanuska, Ruby, Shagluk, Tolstoi and Yakutat. California: Humbolt Co., Lagunitas, Marian Co. and McCloud. Colorado: Alma, Craig, Durango and Kenoske Pass. Maine: Beaver Pond, Brunswick, Camp Caribou, Meadows, Crono, Paris and Portland. Massachusetts: Stoneham. Michigan: Grand Island and Marquette. Minnesota: Duluth and Itasca. Montana: McDonald Lake. New Hampshire: Mt. Washington, Waterville and Webster. New Jersey: Englewood. New Mexico: Capitan. New York: Cicero Swamp, Cranberry Lake, Dundee, Herkimer Co., Ithaca, Mt. Whiteface and Wells. North Carolina: Black Mountain and Pisgah Ridge. Oregon: Astoria, Forest Grove, Santiam and Yarnhill Co. Pennsylvania: North Mountain and Pocono Park. South Dakota: Black Hills and Elmore. Tennessee: Gatlingburg. Utah: Beaver and Uinta National Forest. Vermont: Braintree. Washington: Carson, Easton, Hoquiam, Junction City, Lake Quinault, London, Olympic National Forest and Rock Creek. West Virginia: Bayard, Cranesville, Davis, Delslow, Grant Co., Monogalia Co., Morgantown, Randolph and Tucker Co. Wisconsin: Bayfield Co. Alberta: Banff, Calgary, Edmonton, Jasper, Ledue, Lesser Slave Lake, Nordegg and Olds. British Columbia: Avola, "Chilliwack River", Glacier, Inverness, Lorna, Metlakatla, Mission, Pender Harbor, Queen Charlette Islands, Steelhead, Trinity Valley, Vancouver and Wycliffe. Laborador: Goose Bay. Manitoba: "Piquitenay River".

New Brunswick: Bathurst, Fredericton and "Pisiquic Br". Northwest Territories: Aklavik and Great Bear Lake. Ontario: Frater, Ottawa and Sudbury. Quebec: Aylmer, Duparquet, Isle Perrot, Joliette, "Lake Dunford", "Lake Opasatika", Lake Tremblante, Montreal, "Nalashquan" and Trinity Bay. Yukon Territory: Carmacks.

The heretofore European species, autographus, was described by Ratzeburg in 1837. Since that time this species has been recorded from England, Europe and across Asia to Japan. When Hopkins described americanus in 1915, he stated that his new species was closely related and doubtfully distinct from the European autographus. Swaine (1918) also stated that septentrionis was related to autographus. The type of pseudotsugae has been compared to a Mannerheim specimen of septentrionis by Wood and found to be identical. After a thorough and fruitless search during this study for characters to distinguish these four species, it was concluded that only one variable Holarctic species is represented and that the earliest name, autographus, must be used.

Details of the geographical variation in size found in this species is illustrated on page 7.

This species is commonly found in the base and roots of dying or injured standing trees, and in felled or windthrown trees.

Chamberlin (1939) states that in Douglas fir, the galleries are short and irregular. The winter hibernation galleries are in the inner bark and are larger than the egg galleries.

Dryocoetes betulae Hopkins

Dryocoetes eichhoffi Hopkins, 1894 (nec. Ferrarie, 1867), Canadian Ent. 26: 279; _____, 1904, Yearbook of Agric. 1903: 320; Hagedorn, 1910, Coleopterum Catalogus 4: 67.

Dryocoetes betulae Hopkins, 1915, U. S. Dept. Agric., Rept. 99: 50; Blatchley and Leng, 1916, Rhynchophora of North Eastern America, p. 611; Swaine, 1918, Dom. Canada Dept. Agric. Ent. Branch, Tech. Bull. 14(2): 131; Dodge, 1938, Univ. Minnesota Agric. Expt. Sta., Tech. Bull. 132: 55; Blackman, 1922, Mississippi Agric. Expt. Sta., Tech. Bull. 11: 120; Keen, 1938, U. S. Dept. Agric., Misc. Pub. 273: 169; Chamberlin, 1939, The Bark and Timber Beetles of North America, p. 466; Beal and Massey, 1945, Duke Univ. School of Forest., Bull. 10: 159.

Dryocoetes liquidambaris Hopkins, 1915, U. S. Dept. Agric., Rept. 99: 51; Swaine, 1918, Dom. Canada Dept. Agric. Ent. Branch, Tech. Bull. 14(2): 131.

This species and confusus form a rather sharply defined group characterized by the dense brush of hair on the female frons. It may be separated from confusus by the presence of shallow punctures on the disk of the pronotum, by the flatter, and less strongly impressed declivity and by the host.

Female.— Length 2.8 - 4.5 mm. Mature color reddish-brown.

Frons broad, convex; surface granulate, rather densely clothed with

yellow hairs, (less dense than confusus), not entirely hiding the surface beneath, with a smooth, glabrous, median smooth space, sometimes reaching epistomal margin. Antennal club as long as wide, basal corneous part occupying half or slightly more of the total length. Eye emarginate and granulate.

Pronotum as long as wide, widest at or about middle, anterior margin broadly rounded, sides strongly arcuate; asperate over entire surface except on posterior portion near median line; punctures shallow, obscure and closely placed in median posterior area.

Elytra 1.7 times as long as wide, sides parallel, broadly rounded behind; striae punctured in regular rows, slightly or not at all impressed, the punctures large, impressed; interspaces twice as wide as striae, with numerous, small punctures each bearing a moderately long yellow hair. Declivity flat, sutural and third interspace slightly elevated with a median row of small, prominent granules, second interspace flattened, depressed and granulate, other interspaces granulate toward declivity.

Male.-- Similar to female except frons less strongly granulate and pubescence less abundant; declivity steeper, the sutural and third interspaces more strongly raised, second interspace more strongly depressed, and the granules larger. Male genitalia as illustrated (Fig. 9).

Type Locality.-- Grant County, West Virginia.

Hosts.-- Betula species. Also recorded from Fagus, Pryus and Liquidamber.

Distribution.-- British Columbia to Newfoundland; south in the eastern United States to Mississippi and Florida.

Specimens were examined from: Florida: Mariana. Louisiana: Tallulah. Maine: Beaver Pond, Camp Caribou, "Camp Kennedy" and Machias. Michigan: Grand Island. Mississippi: Leland and Nicholson. Montana: Flathead National Forest. New Hampshire: Franconia and Waterville. New York: Arton, Cranberry Lake, Elka Park, Maplecrest, Staten Island and Syracuse. North Carolina: Pisgah Ridge. Pennsylvania: Cooksberg and La Porte. Vermont: Hancock. Virginia: Dismal Swamp, Saluda, Virginia Beach and Wallaceton. West Virginia: Bayard, Davis, Durbin, Grant Co. and Pickins. Wisconsin: Melatine Falls. Alberta: Lesser Slave Lake. British Columbia: Likely, "Ricketts", and Sugar Lake. New Brunswick: Fredericton and Maple Grove. Newfoundland: St. Anthony. Nova Scotia: Stewiacke. Ontario: Algonquin Park, Frater, Kearney and Thor Lake. Quebec: Black River, Knowlton, "Lake Opasatika" and Montreal.

This is the only North American member of the genus that normally attacks broadleaf trees. It generally attacks trees that are injured or dying and is of no economic importance.

The galleries are irregular with transverse, longitudinal or diagonal branches, according to Beal and Massey, 1945.

Dryocoetes confusus Swaine

Dryocoetes confusus Swaine, 1912, Canadian Ent. 44: 351; _____, 1918, Dom. Canada Dept. Agric. Ent. Branch, Tech. Bull. 14(2): 131; Mathers, 1931, Jour. Econ. Ent. 24: 775; _____, 1931, Canadian Ent. 63: 247; Keen, 1938, U. S. Dept. Agric., Misc. Pub. 273: 163, 165; Chamberlin, 1939, The Bark and Timber Beetles of North America, p. 467; _____, 1958, Scolytidae of the Northwest, p. 188.

Dryocoetes abietis Hopkins, 1915, U. S. Dept. Agric. Rept. 99: 52; Swaine, 1918, Dom. Canada Dept. Agric. Ent. Branch, Tech. Bull. 14(2): 131.

This species is closely related to betulae, but may be separated by the absence of punctures on the pronotal disk, by the very dense mat of hair on the female frons, by the more strongly impressed elytral declivity and by the host.

Female.— Length 3.4 - 4.3 mm. Color of mature specimens reddish-brown to black.

Frons flat; surface granulate, with a shallowly impressed post-epistomal impression, clothed on a circular area by a very dense brush of reddish-brown to yellow hair-like setae, longer at margin; epistomal margin fringed by closely placed yellow hair. Antennal club wider than long, basal corneous part occupying little more than half the total length. Eyes coarsely granulate, shallowly emarginate.

Pronotum 1.1 times wider than long, widest at or near middle;

anterior margin broadly rounded, sides strongly angulate; anterior and lateral portions finely asperate, asperities low, confused, the disk granulate-asperate, clothed by erect reddish hair.

Elytra 1.6 times longer than wide, sides parallel, broadly rounded posteriorly; strial punctures smaller than in other species, weakly impressed in regular rows, sutural striae more impressed; interspaces at least twice as wide as striae, the punctures much smaller and more numerous, each armed by an erect yellowish hair. Declivity convex; strial punctures smaller, obsolete in some specimens; sutural interspace raised and granulate-setose, granules prominent, uniseriate; second interspace impressed, less granulate-setose; third interspace raised.

Male.— Similar to female except frons only sparsely clothed by yellowish hair, surface granulate-punctate, with an impunctate, smooth, median space and a transverse impression just above epistomal margin; elytral declivity with the sutural interspace more strongly elevated and second one more strongly impressed, granules larger. Male genitalia as illustrated (Fig. 10).

Type Locality.— Colorado, exact locality not known.

Hosts.— Abies lasiocarpa, less commonly from other species of Abies and Picea engelmanni.

Distribution.— Throughout the range of its host in western North America from British Columbia to New Mexico.

Specimens examined from: Arizona: San Francisco Mountains. Colorado: Jackson Co., Newcastle, Rabbit Ears Pass and White River National Forest. Idaho: Lakeview and Coeur d'Alene. Montana: Bighorn Co. and Glacier National Park. New Mexico: Coyote. Oregon: Bourne and Sumpter. Utah: Cedar Breaks National Monument, La Sal Mountains, Manti

ational Forest, Wasatch National Forest and Wolf Creek Pass (Duchesne Co.),
Wyoming: Yellowstone National Park and Wapiti. Alberta: Jasper and
 Lesser Slave Lake. British Columbia: Allen Lake, China Valley Ranger
 Station, Copper Basin, Fishtrap, Green Mountains, Hedley, Hope Summit,
 Inverness, Lorna, Merritt, Nicomen Ridge, Stanley, Terrace and Williams
 Lake.

This species attacks Abies lasiocarpa and less commonly other trees
 in the genus Abies. It is the most aggressive North American member of
 the genus and has been known to attack green trees. According to Swaine
 (1918), it attacks and kills healthy balsam in eastern British Columbia
 and northern Alberta. It has also been observed to kill overmature
 alpine fir in Utah.

The gallery consists of a small, circular nuptial chamber entirely
 in the phloem, with several radiating egg galleries which may score the
 sapwood (Keen, 1938).

Dryocoetes granicollis (Leconte)

Xyleborus granicollis Leconte, 1868, American Ent. Soc., Trans. 2: 162.

Dryocoetes granicollis Leconte, 1876, American Philos. Soc., Proc. 15:

861; Hubbard and Schwarz, 1878, American Philos. Soc., Proc. 17:

643; Smith, 1900, Cat. Ins. New York, p. 363; Swaine, 1909, New

York St. Mus. Bull. 134, In Rept. of St. Ent. for 1908, Appendix B,

p. 103; Blatchley and Leng, 1916, Rhynchophora of North Eastern

America, p. 611; Swaine, 1918, Dom. Canada Agric. Ent. Branch,

Tech. Bull. 14(2): 130; Chamberlin, 1939, The Bark and Timber

Beetles of North America, p. 465.

This species is not closely allied to any other species in the North American fauna. Its closest known relative evidently is the European villosus.

It may be distinguished from other North American representatives of the genus by the strongly punctured elytra, by the strongly elevated sutural interspace on the declivity, by the strongly impressed first striae and by the elongate pronotum with its parallel sides.

Female.— Length 2.3 - 3.0 mm. Mature color reddish-brown.

Frons flattened or slightly concave with indistinctly raised longitudinal median line just above epistomal margin, occasionally absent; smooth and minutely granulate, punctured near vertex; lateral areas of epistomal margin slightly raised and granulate. Pubescence consisting of sparsely placed hairs. Eye moderately granulate and

slightly emarginate. Antennal club as long as wide, basal corneous part occupying about half the total length.

Pronotum 1.3 times longer than wide, sides subparallel on posterior two-thirds, anterior margin broadly rounded; basal angles strongly arcuate; anterior and lateral portions finely asperate-granulate, indistinctly subgranulate and punctured on disk; clothed by abundant, moderately long yellow hair.

Elytra 1.32 times as long as wide; sides parallel; striae strongly punctured in regular rows, sutural striae impressed, punctures large and deep; interspaces narrower than striae, the punctures much smaller, each armed by a moderately long, yellow hair. Declivity convex; sutural striae deeply impressed, the punctures large, coarse and close; sutural interspace very strongly elevated and distinctly granulate; other declivital interspaces elevated and granulate.

Male.— Similar to female except frons less densely hairy and declivity steeper with sutural striae more impressed. Male genitalia as illustrated (Fig. 7.).

Type Locality.— Sullivan County, Pennsylvania.

Hosts.— Picea species. There are also records from Juglands, Castanea and Abies, but these probably are accidental hosts, misidentifications or errors in labelling of the host.

Distribution.— An uncommon species in northeastern North America, from Quebec to North Carolina.

Specimens examined from: District of Columbia. Kansas: Douglas Co. Kentucky: Noble. Maine: "Agriculture Experiment Station". New Jersey: Orange Mountains. North Carolina: Tryon. Ohio: Marion Co. Pennsylvania: Arendtsville, Pen Mar and Swarthmore. West Virginia:

Randolph Co. New Brunswick: "Pisiquil Br.". Quebec: Chelsea and Gaspé.

This species is one of the rarest species in this genus in North America. Nothing of the biology is known.

Dryocoetes affaber (Mannerheim)

- trichus affaber Mannerheim, 1852, Bull. Soc. Imp. Nat. Moscow 2: 77.
- eborus affaber, Leconte, 1868, American Ent. Soc., Trans. 2: 162.
- ocoetes affaber, Leconte, 1876, American Philos. Soc., Proc. 15: 361;
Eichhoff, 1879, Roy. sci. soc. Liège, Mem., Série 2, 8: 286;
Schwarz, 1888, Ent. Soc. Washington, Proc. 1: 80; Hopkins, 1893,
West Virginia Agric. Expt. Sta., Bull. 32: 212; Schwarz, 1895,
Ent. Soc. Washington, Proc. 3: 143; Felt, 1906, New York St. Mus.
Mem. 8(2): 752; Swaine, 1909, New York St. Mus. Bull. 134, In
Rept. of St. Ent. for 1908, Appendix B, p. 101; Hagedorn, 1910,
Coleopterorum Catalogus, p. 65; Blatchley and Leng, 1916,
Rhynchopora of North Eastern America, p. 613; Swaine, 1918, Dom.
Canada Dept. Agric. Ent. Branch, Tech. Bull. 14(2): 132; Keen,
1936, U. S. Dept. Agric., Misc. Pub. 273: 165; Dodge, 1938, Univ.
Minnesota Agric. Expt. Sta., Tech. Bull. 132: 55; Chamberlin, 1939,
The Bark and Timber Beetles of North America, p. 467; _____, 1958,
The Scolytidae of the Northwest, p. 189.
- ocoetes pubescens Swaine, 1912, Canadian Ent. 44: 350; _____, 1912,
Dom. Canada Dept. Agric. Ent. Branch, Tech. Bull. 14(2): 132;
Chamberlin, 1939, The Bark and Timber Beetles of North America,
p. 468.
- ocoetes piceae Hopkins, 1915, U. S. Dept. Agric. Rept. 99: 51;
Blatchley and Leng, 1916, Rhynchopora of North Eastern America, p.

613; Swaine, 1918, Dom. Canada Dept. Agric. Ent. Branch, Tech. Bull. 14(2): 30; Dodge, 1938, Univ. Minnesota Agric. Expt. Sta., Tech. Bull. 132: 55; Chamberlin, 1939, The Bark and Timber Beetles of North America, p. 468; Beal and Massey, 1945, Duke Univ. School of Forest., Bull. 10: 160.

This species does not appear to be related to any North American species. It may easily be recognized by the pronotum being widest behind the middle, by the flattened, steep, slightly impressed declivity, by the pubescent female frons and by its size.

It is apparently the most common Dryocoetes in North America.

Female.-- Length 2.5 - 3.3 mm. Mature color dark reddish-brown to almost black.

Frons flattened; surface granulate-punctate, clothed by moderately dense long hair, not hiding the surface beneath, hairs longer and incurved above; epistomal margin fringed with closely placed yellow hair. Antennal club as long as wide, basal corneous part occupying half the total length.

Pronotum 1.1 times as long as wide, widest well behind middle; anterior margin narrowly rounded; sides strongly arcuate; asperate over the lateral areas and anterior half, moderately granulate on disk behind. Pubescence composed of abundant long yellow hair, shorter on disk.

Elytra 1.5 times as long as wide, sides parallel, broadly rounded behind; striae punctures large, smaller toward declivity, impressed in regular rows; interstriae smooth, occasionally roughened, at least twice as wide as striae; the punctures irregular and much smaller than those of striae, somewhat less numerous, each puncture armed by a long yellow hair; sutural interspace elevated slightly on posterior half of disk. Declivity

flat, sutural interspace and third interspace slightly elevated with a median row of prominent granules. Second interspace flattened, impressed, with a median row of prominent granules, less numerous than the striae punctures; other interspaces uniseriately granulate-setose.

Male.— Similar to female except frons with hair less abundant; declivity with first and third interspaces more strongly elevated and with their granules smaller. Male genitalia as illustrated (Fig. 8).

Type Locality.— Alaska, the exact location not given.

Hosts.— Picea species; also recorded from Abies, Larix and Pinus.

Distribution.— The spruce forests of North America from Canada and Alaska south to North Carolina and New Mexico.

Specimens examined from: Alaska: Andreafsky, Eagle, Fairbanks, Fort Yukon, Homer, Juneau, Kenai, Matanuska, McGrath, Naknek Lake, Patterson Bay, Rampert House, Tolstoi and Yakutat. Colorado: Craig, Grand Lake, Gunnison National Forest, Jackson Co., Longmont, Newcastle and Snowmass. Idaho: Coeur d'Alene, Collins, Kaniksu National Forest and Lakeview. Maine: Allagash, Beaver Pond, Camp Caribou, Cupsuptic and Lake Moxie. Michigan: Grand Island and Marquette. Montana: Bozeman, Columbia Falls, Glacier National Park, Lake McDonald and Lincoln Co. New Hampshire: Coos Co., Dixville, Waterville and Wonalancet. New Mexico: Sacramento Mountains. New York: Cranberry Lake and Syracuse. North Carolina: "Pink Beds", Pisgah Ridge and Silver Mountains. Oregon: Ahlers, Cable Cove, Push, Saint Helens and Seaside. Pennsylvania: North Mountain. South Dakota: Black Hills and Elmore. Utah: Beaver, La Sal Mountains, Logan Canyon, Mammoth Mountain and Wolf Creek Pass (Duchesne Co.). Washington: Hoquiam and Lake Quinault. West Virginia: Burbin, Cranesville, Davis, Grant Co., Pocahontas Co., Randolph Co., and Shavers

Fork Mountain. Wisconsin: Point Edwards. Wyoming: Encampment. Alberta: Banff, Edmonton, Jasper National Park, Lesser Slave Lake and Olds. British Columbia: Barkerville, Cherry Creek Valley, Fernie, Glenora, Hedley, Hope Mountains, Inverness, Lorna, Lumby, Merritt, Princeton, Spa Lake, Stanley, Swift River and Vancouver. Laborador: Matamek River. Manitoba: Winnipeg. New Brunswick: Bathurst, Maple Grove, "Pisiquit Br.", Plaster Rock and Tobique River. Northwest Territories: Aklavak, Great Bear Lake and Mackenzie River. Ontario: Algonquin Park, Chalk River, James Bay, Nipigon and Prince Edward Co. Quebec: Aylmer, Gaspé, "Lake Dunford", "Lake Opasatika", Laniel, Montreal, Rupert House and Saint Anne's. Yukon Territory: Carmacks, Dry Creek and Whitehorse.

Hopkins (1915a) described piceae on its smaller size and eastern distribution and Swaine (1912) described pubescens on its apparently larger declivital punctures. From the discussion of characters presented previously it is seen that these characters are merely variations within the population. Therefore, in the absence of consistent morphological differences, only one species is represented.

Keen (1938) states that this species attacks the top of felled and dying spruce in the western United States. It has been observed attacking both the upper and lower bole and stumps of standing and felled spruce in Utah, Colorado, eastern Canada and Alaska.

The adults construct a central nuptial chamber from which the egg galleries, usually three in number, radiate (Chamberlin, 1958).

Dryocoetes sechelti Swaine

Dryocoetes sechelti Swaine, 1915, Canadian Ent. 47: 359; _____, 1918, Dom. Canada Dept. Agric. Ent. Branch, Tech. Bull. 14(2): 130; Chamberlin, 1939, The Bark and Timber Beetles of North America, p. 465; _____, 1958, The Scolytidae of the Northwest, p. 191.

This species is one of the smallest species in the genus. It is allied to, but may be separated from caryi by the smaller declivital punctures on the sutural striae, by the obsolete median line of the frons fed by the host. It may be distinguished from other members of the genus by its small size, by the more strongly precipitous anterior portion of the pronotum and by the steep, flat declivity.

Female.-- Length 2.0 - 2.5 mm. Mature color reddish-brown, legs and antenna sometimes lighter.

Frons convex above; surface densely granulate-punctate, clothed by moderately long yellow hair, with slight transverse impression above epistomal margin, also with longitudinal, scarcely raised, impunctate median line from epistomal margin to vertex; epistomal margin with fringe of closely placed, long yellow hair in median area. Antennal club as long as wide, corneous basal part occupying very slightly less than half of the total length. Eye granulate; shallowly emarginate.

Pronotum widest behind middle; sides slightly rounded, basal angles strongly arcuate, anterior margin moderately rounded; granulate on disk, asperate on anterior and lateral areas, asperities low

confused and closely placed. Pubescence consisting of moderately long yellow hair on sides, shorter on disk.

Elytra 1.4 times as long as wide; sides parallel; stria punctures large, impressed, in regular rows, each puncture usually with a very short hair, sutural striae slightly impressed, others slightly or not at all impressed; interstriae smooth, at least twice as wide as striae, interstria punctures much smaller and more numerous, armed by yellow hair shorter than width of an interspace. Declivity convex above, somewhat flattened below with sutural interspace slightly raised; stria punctures reduced usually becoming obsolete toward apex; interspaces with median row of very small granules each bearing a short yellow hair.

Male.— Similar to female except frons less densely hairy and declivital granules smaller or obsolete. Male genitalia as illustrated (Fig. 6).

Type Locality.— Sechelt, British Columbia.

Host.— Abies lasiocarpa.

Distribution.— Uncommon in western coniferous forests from British Columbia to Colorado.

Specimens examined from: Colorado: Newcastle and Uncompahgre National Forest. Montana: Glacier National Park. Oregon: Suttle Lake. Utah: La Sal Mountains and Logan Canyon. British Columbia: Lorna, Sechelt and Stanley.

This species breeds in the lower portion of the bole in small suppressed trees less than eight inches in diameter (Wood, personal communication).

Dryocoetes caryi Hopkins

Dryocoetes caryi Hopkins, 1915, U. S. Dept. Agric., Rept. 99: 50;

Chamberlin, 1939, The Bark and Timber Beetles of North America, p. 468.

This species is very closely related to sechelti Swaine, but differs in the more prominent, impunctate, longitudinal median line of the frons, and by the large, impressed punctures of the sutural striae which are not reduced on the declivity.

Female.— Length 2.1 - 2.7 mm. Mature color reddish-brown.

Frons convex above, flattened below; surface moderately granulate-punctate, with a prominent, impunctate median line, narrower toward epistomal margin; epistomal margin slightly sinuate, lateral margins not raised. Pubescence short, moderately abundant. Antennal scape about 1.5 times longer than the funicle, widened at the distal end; club round, as long as wide, basal corneous portion occupying half the total length.

Pronotum 1.07 times longer than wide, widest behind middle; sides and anterior margin moderately narrowly rounded, basal angles more broadly rounded; strongly convex in profile, anterior portion steeper and asperate, summit behind middle, uniformly granulate in posterior and lateral portions.

Elytra 1.4 times longer than wide, sides parallel, apex subtruncate with angles broadly rounded; sutural striae slightly impressed, others not impressed, the punctures moderately large and impressed; interspaces

smooth, about one and one-half times wider than striae, punctures minute and more numerous than those of striae. Declivity somewhat flattened; sutural striae slightly impressed with punctures not reduced, second, third and fourth striae with punctures often much reduced to obsolete; interspaces with small, acute granules.

Male.— Similar to female except pubescence of frons shorter and less abundant; declivital granules somewhat larger. Male genitalia as illustrated (Fig. 5).

Type Locality.— Camp Caribou, Maine.

Hosts.— Picea engelmanni, P. rubra and P. glauca.

Distribution.— The northern coniferous forests of North America from British Columbia to Maine, south to North Carolina and Wyoming.

Specimens examined from: Maine: Camp Caribou. North Carolina: Cherokee. Wyoming: Laramie. Alberta: Crowsnest. British Columbia: Lorna. Quebec: Chelsea and Qaspe.

This species evidently is quite rare; only a very few collections having been made since the type was collected. It breeds in the bole of small, weakened, shaded-out, suppressed spruce. In Quebec it was taken in association with Xylechinus americanus Blackman (Wood, personal communication).

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LEGEND

- Fig. 1. Dorsal aspect of pronotum of Dryocoetes granicollis.
- Fig. 2. Dorsal aspect of pronotum of Dryocoetes affaber.
- Fig. 3. Dorsal aspect of pronotum of Dryocoetes autographus.
- Fig. 4. Antenna of Dryocoetes affaber, posterior aspect.
- Fig. 5. Male genitalia of Dryocoetes caryi, lateral aspect.
- Fig. 6. Male genitalia of Dryocoetes sechelti, lateral aspect.
- Fig. 7. Male genitalia of Dryocoetes granicollis, lateral aspect.
- Fig. 8. Male genitalia of Dryocoetes affaber, lateral aspect.
- Fig. 9. Male genitalia of Dryocoetes betulae, lateral aspect.
- Fig. 10. Male genitalia of Dryocoetes confusus, lateral aspect.
- Fig. 11. Male genitalia of Dryocoetes autographus, lateral aspect.

1. GRANICOLLIS

2. AFFABER

3. AUTOGRAPHUS

5. CARYI

6. SEHELTI

7. GRANICOLLIS

4. AFFABER

8. AFFABER

9. BETULAE

10. CONFUSUS

11. AUTOGRAPHUS

BARK BEETLES OF THE GENUS DRYOCOETES
(COLEOPTERA: SCOLYTIDAE) IN NORTH AMERICA

AN ABSTRACT
SUBMITTED TO
THE DEPARTMENT OF ZOOLOGY AND ENTOMOLOGY
BRIGHAM YOUNG UNIVERSITY

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF
MASTER OF SCIENCE

BY
DONALD EDWARD BRIGHT, JR.

JUNE, 1961

This abstract by Donald Edward Bright, Jr. is accepted in its present form by the Department of Zoology and Entomology of Brigham Young University as satisfying the abstract requirement for the degree of Master of Science.

June, 1961

ABSTRACT

Approximately 4,000 specimens of the North American species of the bark beetle genus Dryocoetes was examined during this taxonomic study. Complete descriptions and a key were prepared for the seven North American species. Distributional data, biological notes and a bibliography for each species are presented. The morphological characters useful in this classification are discussed and utilized to establish an apparent phylogeny.

The important external characters used in this classification include the shape and sculpture of the pronotum, the pubescence of the female dorsum, the degree of impression of the sutural striae on the declivity and the shape of the declivity. The most significant characters were found in the shape of the endophallic portion of the male genitalia which are illustrated.

Of the twelve species previously described from North America, five are placed in synonymy. The new synonymy included follows: Dryocoetes autographus (Ratzeburg) (= D. septentrionalis (Mannerheim), D. americanus Hopkins and D. pseudotsugae Swaine) and D. affaber (Mannerheim) (= D. borealis Hopkins and D. pubescens Swaine).

Dryocoetes autographus (Ratzeburg), a Eurasian species, is recognized for the first time in North American fauna. Significant extensions of the distributions of sechelti Swaine and caryi Hopkins are included.