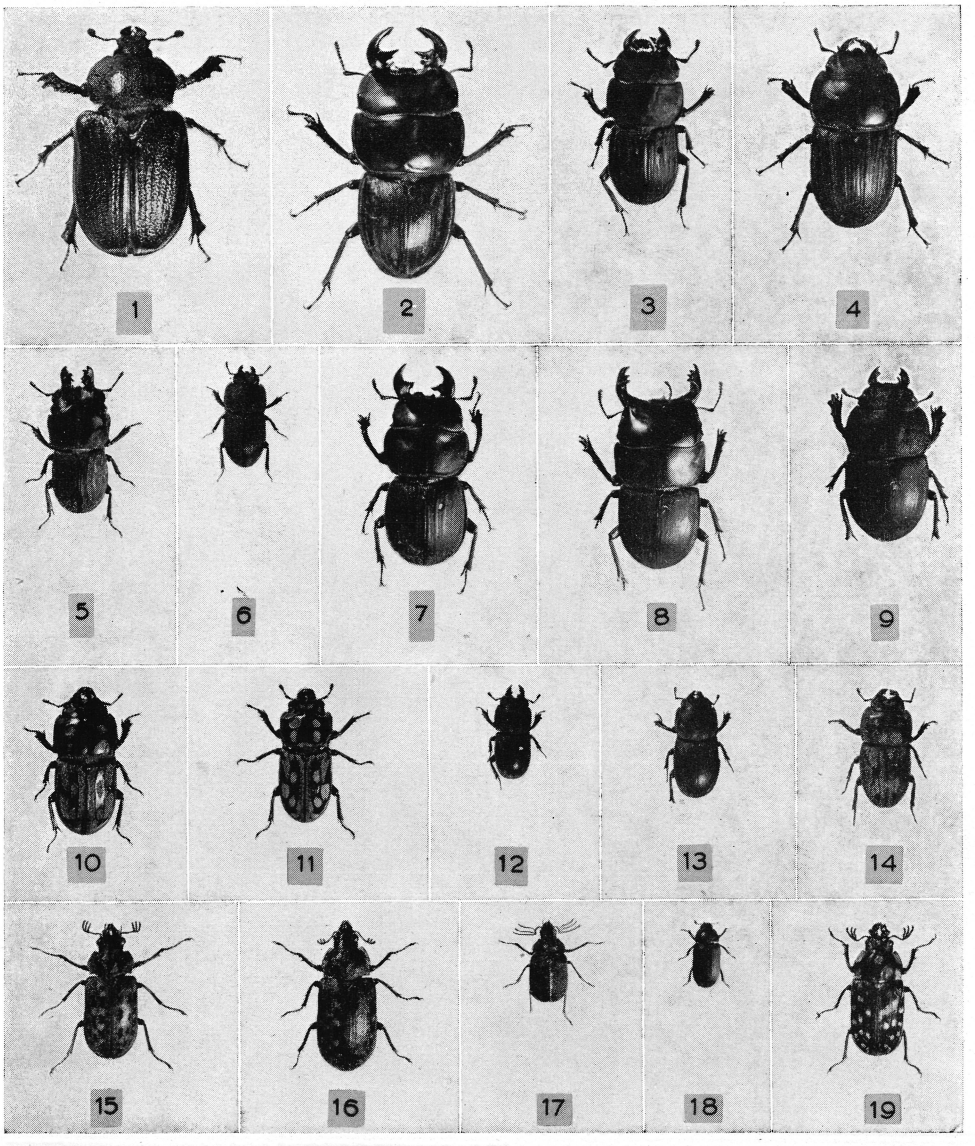

—*R. K. Dell, photo.*

FRONTISPIECE: Some New Zealand Stag Beetles (Lucanidae). 1, *Dendroblax earlii* White, female; 2, 3, *Dorcus helmsi* (Sharp), males; 4, *D. helmsi* (Sharp), female; 5, *Dorcus novaezealandiae* (Hope), male; 6, *D. novaezealandiae* (Hope), female; 7, *Dorcus philpotti* (Broun), male; 8, *Dorcus ithaginis* (Broun), male; 9, *D. ithaginis* (Broun), female; 10, *Lissotes reticulatus* (Westwood), female; 11, *Lissotes rufipes* Sharp, male; 12, *Lissotes stewarti* (Broun), male; 13, *L. stewarti* (Broun), female; 14, *Lissotes planus* (Broun), male; 15, *Ceratognathus parrianus* (Westwood), male; 16, *C. parrianus* (Westwood), female; 17, *Ceratognathus gibbosus* Broun, male; 18, *Ceratognathus cylindricus* (Broun), male; 19, *Ceratognathus foveolatus* Broun, male. Approx. actual size.

DOMINION MUSEUM BULLETIN No. 20

A Systematic Revision of the New Zealand Lucanidae (Insecta: Coleoptera)

by

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DOMINION MUSEUM, WELLINGTON, NEW ZEALAND
SEPTEMBER 1961

CONTENTS

A Systematic Revision of the New Zealand Lucanidae (Insecta: Coleoptera)

ABSTRACT

Twenty-four species are recognized for the New Zealand area, including the Chatham Islands. They belong to four genera: *Dendroblax* White, *Dorcus* Macleay, *Lissotes* Westwood, *Ceratognathus* Westwood. One new species is described, 13 specific names are placed in new synonymy, and six new combinations are proposed. The morphology of the New Zealand lucanids is discussed and the taxonomic value of certain structures is considered. All the previously known species are redescribed and morphological structures of each species are illustrated, special attention being given to both male and female genitalia. Keys to genera and species are provided, and the distribution of each species is given. Notes on the biology of some species are included. The affinities of the New Zealand species are discussed. There is a strong Australian element, a New Guinea-Australian-South American element, and what appears from present evidence to be a New Guinea-Oriental element. Some remarks on the classification of the entire family are included.

INTRODUCTION

This paper is a first revision of the Lucanidae of the New Zealand region including the Chatham Islands and all the offshore islands of New Zealand. The family is one of several which have long been in need of revision. The descriptions of all the lucanid species occurring in the region have been based either on single specimens or on very small series, and many have been described without knowledge of or comparison with previously described species. Since sexual dimorphism and allometry are marked in many species, and there is also a considerable amount of individual variation in puncturation, coloration and arrangement of vestiture,

shape of mandibular teeth, and other characters to which earlier writers attributed taxonomic importance, it is not surprising to find that the literature on the New Zealand Lucanidae contains a great many synonyms. Frequently, the taxonomic characters used by one author in describing a species have been very different from those selected by other authors for describing species of the same genus, and in many instances the brief descriptions that are given make recognition of the species impossible without reference to their types. The present writer has been able to examine all the Broun types in the British Museum (Nat.Hist.) and other New Zealand lucanid types at the British Museum and in the Hope Collection at Oxford University. All the previously known species are redescribed so that the same characters are considered for all species of any one genus, and the intraspecific variation apparent in the large series of specimens assembled for this revision is recorded.

Probably the most interesting part of a study such as this is the picture which emerges concerning the evolution of the species groups within New Zealand and the relationships of these to non-endemic groups. In the past, intrafamilial grouping within the Lucanidae has been based, to a large extent, on superficial similarities of structures such as mouthparts. In many instances these similarities seem to have resulted from convergence and probably do not have any phylogenetic significance. The present writer considers that the genitalia of both males and females offer the most reliable characters on which to establish relationships at all levels in the family, and consequently the morphology of these has been very fully discussed in the present paper. The illustrations of the genitalia have been grouped so that comparisons can readily be made between all species of one genus.

This revision does not include descriptions of non-endemic species. Only one introduced species, *Ryssonotus nebulosus* (Kirby) has been recorded from the area. According to Gourlay (1954), this Australian species, which was first reported from New Zealand in 1950, probably was introduced in eucalypt timber and may have become established in Gisborne.

CHARACTERISTICS OF THE NEW ZEALAND LUCANID FAUNA

(a) COMPOSITION

In the most recent catalogue of the Lucanidae (Benesh, 1960), approximately 1,000 species are recognized. Of these, 35 species are listed as belonging to the New Zealand area, including the Chatham Islands. The present revision recognizes only 24 species, including one new species, from the New Zealand region. They belong to four genera: *Dendroblax* White, *Dorcus* Macleay, *Lissotes* Westwood, and *Ceratognathus* Westwood. *Dendroblax,* with one species, is endemic to the area. *Ceratognathus* is a non-endemic genus with 11 species in the New Zealand region, one of these being restricted to the Chatham Islands. *Lissotes* and *Dorcus* each with six species in the New Zealand area, are non-endemic genera, but it should be noted that the New Zealand species groups of both these genera will probably be given generic status when the systematics of the remaining species are better known. One of the New Zealand species of *Dorcus* is restricted to an offshore island and another species is confined to the Chatham Islands.

(b) GEOGRAPHIC DISTRIBUTION

The distribution of each species is summarized in the taxonomic section, and the locality records from the specimens examined are grouped under provinces which are listed from north to south throughout New Zealand. The total number of species is approximately evenly divided between the North and South Islands; only three species, two of which are endemic, have been recorded from the Chatham Islands. Species of the four genera occur in the North and South Islands; only two genera have so far been recorded from Stewart Island and the Chatham Islands.

The single species of *Dendroblax* is fully winged and occurs in both the North and South Islands. It has not been recorded from Stewart Island or the Chatham Islands. The 11 species of *Ceratognathus* are fully winged; of these, one species is restricted to the Chatham Islands, two species have been recorded from the South Island only, and two species are known from only the North Island. The remaining six species occur in both the North and South Islands, one of these species having been recorded also from the Chatham Islands, another from the Kermadec Islands, and a third from Stewart Island.

The New Zealand species of *Dorcus* and *Lissotes* have vestigial wings and the distribution of most of the species is very restricted. Four species of *Lissotes* occur in the North Island only, one species appears to be endemic to the South Island, and one species occurs in both the North and South Islands. *Lissotes* has not been recorded from the Chatham Islands or from Stewart Island. Of the six species of *Dorcus* occurring in the New Zealand area, one species is confined to the Mokohinau Islands, another is endemic to the Chatham Islands, and two are known from the North Island only. The remaining two species of *Dorcus* are from the South Island, the range of one species extending into the Stewart Island area.

(c) AFFINITIES

Three distinct zoogeographic elements can be recognized in the lucanid fauna of the New Zealand area. There is a strong Australian element, a New Guinea-Australian-South American element, and what appears from present evidence to be a New Guinea-Oriental element.

The Australian element is represented by *Ceratognathus* and *Lissotes*. The genus *Ceratognathus* has its species approximately equally distributed between the New Zealand area and Australia including Tasmania. In a previous paper (Holloway, 1960) the writer has shown that *Ceratognathus* is allied to *Aesalus* Fabricius, a small genus with species scattered throughout the Northern Hemisphere. The relationship of *Ceratognathus* and *Aesalus* to other genera is not clearly understood at the present time. *Lissotes* is shared by Australia, Tasmania, and New Zealand, most of its species occurring in Tasmania. It has already been pointed out in this revision that the New Zealand species group of *Lissotes* may warrant generic rank. The relationship of *Lissotes* to other genera is not known, but the New Zealand species share a large number of morphological features with species of *Pycnosiphorus* Solier from South America. Further studies may prove that a real relationship exists between these genera.

The relationship of *Dendroblax* to other lucanids has been discussed fully by the writer (Holloway, 1960). *Dendroblax* is allied to *Streptocerus* from South America and to the New Guinea and Australian genera *Lamprima* Latreille and *Phalacrognathus* Macleay. Endemic species of *Lamprima* also occur on Norfolk Island and Lord Howe Island. It has been shown (Holloway, 1960) that the South African genus *Colophon* Gray is not allied to these genera as had previously been supposed by several authors (Didier and Séguy, 1953; Landin, 1955; Brinck, 1956; Benesh, 1960).

Dorcus as presently understood (Benesh, 1960) is a widespread genus with most of its species occurring in the Oriental region and New Guinea. A few species occur elsewhere in the Northern Hemisphere. The whole genus is urgently in need of review; the writer considers that the New Zealand species group of the genus *Dorcus* will probably be given generic rank at a later date. All the New Zealand species of *Dorcus* have vestigial wings in contrast to most (? all) of the non-endemic species of this genus which are fully winged.

MORPHOLOGY AND MEASUREMENTS

The taxonomic value and possible phylogenetic significance of certain morphological structures in the Lucanidae in general have been considered by the writer in an earlier paper (Holloway, 1960). Some morphological characters which have proved to be very useful taxonomically in the present revision are discussed below. In most of the New Zealand lucanids sexual dimorphism is marked, and allometry is apparent in males of many species; intraspecific variation resulting from these two factors is discussed in the taxonomic section of this revision.

Colour.—In most of the New Zealand species the cuticle is uniformly coloured, ranging in individual specimens from reddish-brown to black. A few species have the cuticle of the dorsal surface mottled with brown and somewhat iridescent black blotches. In some species of *Dorcus, Lissotes,* and *Ceratognathus* colour patterns are produced by groups of scales which differ in colour from the cuticle.

Surface Texture.—In a few species the surface is glossy, but in most it appears dull, mainly because of the vestiture of scales and setae. Usually the underside of the body is more glabrous than the dorsal side.

The cuticle may be finely to very coarsely punctate, and in most species the coarse punctures bear setae or scales. In general, fine punctures are naked. The vestiture of the dorsal surface consists mainly of scales, that of the ventral surface mainly of setae. The terminology used in describing the angle of inclination of the vestiture to the cuticle is illustrated in Fig. 9 and is adopted from an unpublished doctoral thesis of F. H. Werner (1950, Harvard University). In most species, erect scales and setae occur only on the head, mainly near the eyes; vestiture of the remainder of the dorsal surface tends to be appressed. In some species, coarse punctures bearing scales are grouped in depressions of the cuticle on the head, pronotum, and elytra, or are aligned in bands on the elytra. Standing scales are easily abraded in some species of *Dorcus* and *Lissotes.*

HEAD

The head may be short and broad or long and narrow, depending on species and sex, and it usually exhibits pronounced sexual dimorphism and allometry. In males of *Dorcus,* the sides of the head are produced into one or more angulate lobes behind the eyes; the shape and number of these are useful for identifying species. Head width is measured on the dorsal surface and includes the eyes.

Eyes.—The eyes are entire and large in *Dendroblax.* In *Ceratognathus* they are undivided and vary from small to very large, the size being a useful taxonomic character. In *Dorcus* and *Lissotes* the eyes are partially divided by a canthus and are small. In most species of *Ceratognathus* eyes of males are much larger than those of females. In *Lissotes* and *Dorcus* the eyes of females tend to be larger than those of males.

Antennae.—The antennae are 10-segmented and the last three segments form a club. Depending on the way in which the second antennal segment articulates on the scape, the antennae may be described as geniculate, non-geniculate, or partially geniculate. These three forms of articulation are illustrated in Figs 1 to 3 and have been discussed in detail previously by the writer (Holloway, 1960). The antennae are geniculate in *Lissotes* and *Dorcus,* non-geniculate in *Ceratognathus,* and partially geniculate in *Dendroblax.* The manner in which width and depth of the club are measured is shown in Figs 4 and 5. In *Dendroblax, Lissotes,* and *Dorcus* the club segments are stout and capable of being opposed; in *Ceratognathus* they are incapable of being opposed and usually are stout in females and more or less filiform in males. In males of *Ceratognathus* the form of the antennal club is very useful for separating species.

Intermandibular Projection and Labrum.—The intermandibular projection is a median extension, between the mandibles, of the clypeus or fused clypeus, frons and labrum. It is not separated from the posterior part of the head by a suture. When a distinct lobe, marked off by a suture, is present on the anterior part of the intermandibular projection it is referred to in the present paper as the labrum. The writer (1960) has previously pointed out the difficulties in distinguishing between labrum, clypeus, and frons in adult lucanids. A distinct intermandibular projection is present in *Dendroblax* and in most species of *Ceratognathus;* it is indistinguishable or absent in *Lissotes* and *Dorcus.* The shape of the intermandibular projection and the plane in which it lies have taxonomic value in *Ceratognathus.* The shape of the labrum and the occurrence on it of tubercles and setae are useful in making specific identifications.

Frontal Depression and Tubercle.—In some species the frons varies intraspecifically from irregularly concave to convex and its shape therefore has no taxonomic value. However, in most species of *Lissotes* there is always a distinct triangular depression on the frons. A small tubercle is present near the anteromedial edge of the eye in some species.

Maxillae.—These contain some of the most important taxonomic characters for separating the New Zealand genera. Maxillae of representatives of the genera are shown in Figs 11 to 15. Taxonomically, the most important part of the

maxilla is the lacinia. This terminates in a hook in females of *Dorcus* and in both males and females of *Lissotes;* in *Dorcus* males the lacinial tip is sclerotized but not hooked. In both sexes of *Dendroblax* the lacinia terminates in a slightly curved blade. The lacinia in males and females of *Ceratognathus* is very small and lacks armature. A few stout spines or hooklets occur beneath the lacinial hook in some species of *Lissotes* and *Dorcus.* Galeal hooks occur in *Lissotes.* The possible correlation between maxillary armature and mandible size has been discussed in detail elsewhere (Holloway, 1960). The shape of the terminal segment of the maxillary palp is useful taxonomically for separating some species of *Dorcus.*

Labium.—Labia typical of the New Zealand genera are shown in Figs 16 to 20. The shape and size of the mentum can be used for separating some species. The outer surface of the mentum may be coarsely or sparsely punctate and in some species a tubercle is present near the centre. The ligula is large and bifurcate in *Lissotes* and *Dorcus;* it is small and divided in *Dendroblax.* In *Ceratognathus* the ligula is small and may be either notched or convex distally, depending on the species. Sexual dimorphism and allometry produce marked differences in the labial palps of some species.

Mandibles.—In males of most species the mandibles are large and contain some good specific differences. In *Dorcus,* allometry is striking and sexual dimorphism is marked. In *Dendroblax* and a few species of both *Lissotes* and *Ceratognathus* the mandibles are identical or very similar in both sexes and allometry is not discernible, but in most species of *Lissotes* and *Ceratognathus* sexual and allometric differences are apparent in the mandibles. In general, mandibles of females are small and contain few taxonomic characters. The vestiture of the mandibles has not been indicated in the illustrations accompanying this revision.

THORAX

Pronotum.—The pronotal surface is tuberculate in some species of *Ceratognathus* and *Lissotes* but in most of the New Zealand species it is smooth. The sides of the pronotum may have a rim or brim. In some species of both *Ceratognathus* and *Lissotes* scales are arranged in specifically distinct patterns on the disc. The pronotal measurements and terminology are shown in Fig. 6.

Elytra.—The shape, colour, arrangement, and angle of inclination of the elytral scales and setae can be used for distinguishing most species. In some species the sides of the elytra are brimmed, and the elytral suture may be elevated. Elytral tubercles occur in one species.

Hindwings.—These are fully developed in *Dendroblax* and *Ceratognathus.* In *Dorcus* and *Lissotes* the hindwings are vestigial and offer good taxonomic characters in their shape, size, and venation, but, since the species of both genera are readily differentiated by more accessible characters, details of the hindwings have not been included in this revision.

Thoracic Sternites and Coxae.—These offer some good generic characters. In *Dorcus* (Fig. 7) and *Lissotes* the procoxae are widely separated by a broad prosternal process. In *Dendroblax* (Fig. 8) and *Ceratognathus* (Fig. 9) the pro-

sternal process is very narrow and does not extend ventrally as far as the medial edges of the coxae. The prosternal process is tuberculate in some species. In *Dendroblax* and *Ceratognathus* the anterior face of the procoxa is produced into a small lobe, the procoxal process (see Figs 8 and 9). There are no procoxal processes in *Dorcus* and *Lissotes* (see Fig. 7).

Legs.—The shape of the anterior tibia and the arrangement and size of the teeth along its outer edge are useful for identifying many species. Some species of *Dorcus* can be identified by the shape of the tibial spurs. The extent of the vestiture on the ventral surface of the tarsal segments is interspecifically variable in *Ceratognathus.*

ABDOMEN

Fifth Abdominal Sternite.—In *Dorcus* and *Lissotes* this sternite does not offer any significant taxonomic or sexual characters, but in *Ceratognathus* the shape of its distal margin is distinctive for most species and is different in males and females.

Male Genitalia.—In a previous paper (Holloway, 1960), the writer has discussed at some length the taxonomic value of male genitalic structures in the Lucanidae. The terminology used by the writer is that proposed by Lindroth (1957). In the illustrations accompanying the present revision the various parts of the male genitalia have been labelled for one species of each genus. The structures referred to by the writer as scales on the internal sac are flattened microtrichia, not modified setae, and the direction in which they point is stated with reference to the everted internal sac.

The four New Zealand genera are readily distinguished by the form of the male genitalia. In *Ceratognathus* there are no paired struts within the tegmen, the internal sac is eversible, the basal piece of the tegmen is much shorter than the parameres, and the penis is enclosed by or fused to the basal piece. In *Lissotes* and *Dorcus,* paired struts are present within the tegmen, the internal sac is permanently everted, and the penis rests on the distal end of the basal piece. In *Dendroblax,* paired struts are present, there is an eversible internal sac, and for more than half its length the penis is enclosed by the basal piece.

The parameres exhibit striking interspecific variation in form in *Ceratognathus,* but in the other genera they have very little taxonomic value. There is considerable interspecific variety in the shape of the permanently everted internal sac in both *Dorcus* and *Lissotes,* and these genera are separable on the basis of differences in the sac.

Female Genitalia.—The terminology used is that recommended by Lindroth (1957). In the illustrations accompanying the present paper, the various parts of the female genitalia have been labelled for one species of each genus. The position and shape of the spermatheca, bursa copulatrix when present, bursal duct, spermathecal gland, and accessory gland are important for identifying the New Zealand genera and species. The styli and hemisternites exhibit a considerable amount of intraspecific variation in shape and therefore have limited taxonomic value.

STUDY MATERIALS AND METHODS

Material from the following collections has been examined in this revision; the letters are those by which the collections are referred to in the text.

AM	Auckland Institute and Museum, New Zealand
BMNH	British Museum (Nat.Hist.), London
CI	Cawthron Institute, New Zealand
CM	Canterbury Museum, New Zealand
DM	Dominion Museum, New Zealand
EG	Private collection of Mr E. S. Gourlay, Nelson, New Zealand
MCZ	Museum of Comparative Zoology, Harvard College, Massachusetts
PDD	Plant Diseases Division, D.S.I.R., Auckland, New Zealand

The methods used for preparing the genitalia for study have been described in an earlier paper (Holloway, 1960, p. 326). It is important that the abdominal contents *be removed in one piece* and macerated in a *cold* 10 per cent. solution of potassium hydroxide. If the abdominal contents are *boiled* in potassium hydroxide, some of the feebly sclerotized ducts of the female genitalia are likely to be destroyed. The genitalia and mouthparts when removed have been placed in a few drops of glycerine in a genitalia vial accompanying the specimen.

Genitalia and mouthparts of most specimens were examined in a dish of alcohol under a stereoscopic microscope. Parts requiring a magnification greater than 90X were temporarily mounted in glycerine on a slide and examined under a compound microscope. In males having an eversible internal sac, it was sometimes possible to evert the sac artificially by means of a hypodermic syringe (see Sharp and Muir, 1912, p. 483) or by pulling the sac back through the ostium, using hooked needles and forceps.

The illustrations were made by using either a camera lucida or a squared disc.

CLASSIFICATION

An historical review of lucanid classifications has been given in an earlier paper (Holloway, 1960). Two major catalogues of the Lucanidae of the world have been published in recent years (Didier and Séguy, 1953; Benesh, 1960). The Didier and Séguy catalogue recognizes and keys out the following 10 subfamilies: Chiasognathinae, Lampriminae, Lucaninae, Chalcodinae, Cladognathinae, Dorcinae, Figulinae, Syndesinae, Aesalinae, Sinodendroninae. Benesh's catalogue divides the Lucanidae into the following eight subfamilies, five of which are composed of two or more tribes: Sinodendrinae, Syndesinae, Aesalinae, Penichrolucaninae,

Figulinae, Lampriminae, Dorcinae, Lucaninae. The Benesh catalogue is part of the Junk *Coleopterorum Catalogus* and, in conformity with other parts of the series, neither contains keys to the subfamilies and tribes nor discusses the basis for the classification that is proposed.

The classification used in both the above catalogues seems to be based mainly on the form of the mouthparts, antennae, and eyes, and does not, so far as the present writer is aware, take into consideration the structure of the genitalia.

In an earlier paper (Holloway, 1960), the writer discussed the apparent taxonomic and phylogenetic value of certain morphological characters in the Lucanidae and suggested that the male genitalia offer the most stable and significant characters on which to establish relationships. After a detailed examination of genitalia and certain other structures in species of several genera, the writer (1960) concluded that at least three distinct lines could be recognized in the family. One of these, the Lampriminae, includes *Lamprima, Dendroblax, Streptocerus,* and *Phalacrognathus,* but does not include *Colophon, Ryssonotus* Macleay, *Chiasognathus* Stephens, *Pholidotus* Macleay and *Sphenognathus,* all of which have at some time been referred to this subfamily (see Didier and Séguy, 1953; Landin, 1955; Brinck, 1956; Benesh, 1960). The present writer also concluded that the Aesalinae is a monophyletic group which includes *Aesalus* and *Ceratognathus; Ceruchus,* which has been placed in this subfamily by most authors does not possess typical aesaline characters and probably does not belong in the Aesalinae. The third monophyletic group recognized by the writer is the Lucaninae which possibly should be extended to include Chiasognathinae, Figulinae, Cladognathinae, Dorcinae and Chalcodinae.

Until more detailed work has been carried out on the morphology of most of the lucanids it probably would be better for authors who are compiling catalogues of the world fauna to list genera alphabetically rather than to refer them to subfamilies and tribes to which they possibly do not belong. In view of the lack of agreement as to the number and limits of subfamilies and tribes in the Lucanidae the intrafamilial grouping of the New Zealand species has not been stressed in the present paper. However, on the basis of male genitalic structure the genera can be placed in the following groups which probably do represent actual subfamilies.

(1) Paired struts present. Internal sac not permanently everted. Basal piece of tegmen very large, much longer than parameres, cylindrical, and enclosing more than half the length of the penis. *Dendroblax* (Subfamily Lampriminae).

(2) Paired struts present. Internal sac permanently everted. Basal piece of tegmen not markedly longer or shorter than parameres, incompletely sclerotized dorsally, and not enclosing the penis. Penis resting on distal end of basal piece. *Dorcus, Lissotes* (Subfamily Lucaninae).

(3) Paired struts absent. Internal sac not permanently everted. Basal piece of tegmen much shorter than parameres. Penis partially enclosed by or apparently fused to basal piece. *Ceratognathus* (Subfamily Aesalinae).

TAXONOMY

CHARACTERIZATION OF THE FAMILY

Family LUCANIDAE Latreille

The most recent definition of the family is that of Didier and Séguy (1953) which is quoted in free translation.

"Head usually transverse, of medium, large, or very large size. Labrum fused with the clypeus; epistoma more or less projecting, usually corneous. Mandibles projecting, sometimes strongly projecting, always destitute of membranous internal parts, polymorphic according to sex, species, or genus, usually better developed in males; molar teeth absent. Galea usually membranous and ciliated. Ligula free, membranous, bilobed, penicillate, separated from mentum. Eyes entire or more or less divided by a lateral prolongation of the head capsule or canthus. Antennae 10-segmented; club fan-shaped, composed of three to seven segments which are not very movable basally. Abdomen with five visible sternites; pygidium covered below by the last sternite, covered above by the elytra."

KEY TO THE NEW ZEALAND GENERA OF LUCANIDAE

(1)	Procoxal process absent; prosternal process broad and extending ventrally as far as procoxa; eye partially divided by a canthus	2
	Procoxal process present; prosternal process very narrow and not extending ventrally as far as procoxa; eye entire	3
(2)	Lacinia terminating in a hook in both males and females; permanently everted internal sac with three pairs of sclerites; bursa copulatrix partially pigmented dorsally	*Lissotes* Westwood, p. 41
	Lacinia terminating in a hook in the female, in a straight blade in the male; permanently everted internal sac with not more than one pair of sclerites; bursa copulatrix not pigmented	*Dorcus* Macleay, p. 16
(3)	Lacinia large, terminating in a slightly curved blade in both males and females; aedeagus with a pair of struts which lie within the basal piece and articulate on the proximal end of the penis; accessory gland opening directly into vagina	*Dendroblax* White, p. 11

Lacinia extremely small and unarmed in both males and females; aedeagus with no struts within the basal piece; accessory gland not opening directly into vagina ..... *Ceratognathus* Westwood, p. 61

DENDROBLAX WHITE

Dendroblax White, 1846, *Voy.Erebus and Terror. Insects,* p. 9. Type species: *Dendroblax earlii* White (monobasic).
Range.—New Zealand.

The distinctive external characters of *Dendroblax* are the large, entire eyes, narrow prosternal process, minute ligula, and the maxilla, which, in both sexes, has the lacinia terminating in a strongly sclerotized, slightly curved blade. Sexual dimorphism is very slight and allometry is not apparent.

Body large, broad, convex, and rather dull. Head short and narrow; intermandibular projection short and broad, almost vertical, not receding; postocular margin very short, not swollen. Labrum distinct, immovable, long, narrow, vertical, not at all translucent. Mandibles porrect, almost symmetrical, short, robust, very deep dorsoventrally; each with a large dorsal tooth (hollowed out above) and a small, basal, ventral tooth. Maxilla as in Fig. 11; galea short, without spines; lacinia with a few slightly curved, small spines below the terminal blade; second segment of palp longer than third; terminal segment not dilated. Labium as in Fig. 16; mentum small, approximately semicircular, very setose externally, and not covering base of first segment of labial palp; ligula divided, not very setose, not extending beyond first segment of labial palp; labial palp stout, second segment longer than first, terminal segment dilated in female, not in male. Antenna short and incompletely geniculate (Fig. 3); scape slender, about half the length of entire antenna; club composed of three stout, unequal segments which are covered with short, fine hairs and are capable of being opposed.

Scutellum large; clearly visible between elytra. Prosternal process not extending ventrally as far as procoxal process. Mesosternal process narrow. Wings fully developed. Legs strongly fossorial; procoxal process (Fig. 8) moderately large; medial edges of coxae close; arolium large, projecting well beyond fifth tarsomere and with at least 12 bristles; anterior tibia large, strongly toothed; middle and hind tibiae prominently expanded distally, with the distal end very concave, especially in the hind tibia; fore and middle tibiae with one and two narrow, flattened spurs respectively; hind tibia with two spatulate spurs.

MALE GENITALIA

The characteristic features of the male genitalia are the long, armed, eversible internal sac terminating in a hook, the long, cylindrical basal piece enclosing more than half the length of the penis, the short parameres, and the pair of struts

lying within the basal piece and articulating on the proximal end of the penis. The aedeagus is symmetrical, very strongly sclerotized, and deeply pigmented. The penis is shorter than the tegmen and has the form of a uniformly sclerotized cylinder, which is slightly expanded proximally. The ostium is terminal; basal orifice small and basal. Two extensive sclerotized plates arising dorsally from near the base of the penis connect the parameres and the penis. A short, median rod arising dorsally from the base of the penis extends slightly beyond the proximal, dorsal edge of the basal piece.

The ninth abdominal segment is approximately 0·9 times the length of the aedeagus. It is symmetrical, finely and densely pubescent, and less strongly sclerotized than the aedeagus.

FEMALE GENITALIA

The female genitalia of *Dendroblax* differ from those of other New Zealand lucanids in having a long, broad, strongly sclerotized spermathecal duct connecting the large spermatheca directly with the vagina; there is no distinct bursa copulatrix. The hemisternites are strongly sclerotized and deeply pigmented; each bears at its tip a small, setose stylus. The spermathecal gland is soft, colourless, very small, and has a distinct duct which opens near the base of the spermatheca. A small saccate accessory gland enters the vagina near the level of entry of the median oviduct.

It has been shown in an earlier paper (Holloway, 1960) that *Dendroblax* has affinities with the Chilean genus *Streptocerus* Fairmaire and with the Australian and New Guinea genus *Lamprima* Latreille. *Dendroblax* differs strikingly from these two genera in the almost complete absence of sexual dimorphism and in the presence of armed maxillae in both sexes. The male genitalia of the three genera are very similar (Holloway, 1960). The female genitalia of *Dendroblax* differ from those of *Lamprima* and *Streptocerus* mainly in the absence of a bursa copulatrix and in the small size of the accessory gland.

Dendroblax contains a single, highly variable species.

Dendroblax earlii White

Frontispiece, 1

Figs 3, 8, 11, 16, 20, 21, 97–103

Dendroblax Earlii White, 1846, *Voy. Erebus and Terror. Insects*, p. 9; pl. 2, figs 9, 10; sex not determined; original description. Type locality: Hutt River, Port Nicholson, New Zealand. (White also uses *Dendrobius Earlianus* in the description and *Dendroblax Earlianus* on the figures.)

Dendroblax Earlianus White, Westwood, 1855, *Trans. ent. Soc. Lond.*, new series, 3: 213.

Dendroblax Earlei White, Lacordaire, 1856, *Gen. Coléopt.*, Atlas, pl. 25, fig. 2. Roon, 1910, *Coleopt. Catal.*, pt. 8: 6. Boileau, 1913, *Trans. ent. Soc. Lond.*, p. 216. Arrow, 1935, *Trans. R. ent. Soc. Lond.*, 83: 122. Didier and Séguy, 1953, *Encyc. Ent.*, (A) 27: 73.

Dendroblax acutangulus Arrow, 1935, *Trans. R. ent. Soc. Lond.*, 83: 122; sex not determined; original description. Type locality: Greymouth, New Zealand. NEW SYNONYMY.

Body chocolate or deep reddish-brown, not very glossy. Dorsal surface of head and pronotum coarsely and densely punctate; elytra less densely punctate, slightly rugose and with several broad, longitudinal grooves. Most of the punctures of the dorsal surface bear minute, inconspicuous, decumbent, pale setae. Ventral surface finely and densely punctate except for the middle third of the first through fourth abdominal sternites which is more sparsely and coarsely punctate. The punctures of the ventral surface bear appressed to decumbent, fine, fulvous hairs which are long and flexible on the metasternum, shorter and stiffer elsewhere.

Head (Fig. 20) with the surface between and anterior to the eyes irregularly convex to concave; anterior edge shallowly emarginate, and in some specimens with a narrow, low rim; preocular margin varying in shape from obtusely rounded to acutely and sharply angular, and slightly to prominently arched over scape base; width of eyes together one-quarter to one-third the total head width. From near the outer edge of the mandible base a short, narrow, irregular ridge extends posteromedially across the head and ends in a small tubercle. Labrum rounded distally; outer surface slightly convex with coarse, moderately dense punctures bearing long setae. Mandibles (Figs 20 and 21) coarsely and densely punctate, some of the punctures bearing short, fine setae. The mandibular teeth show a large amount of individual variation in size and shape; the dorsal tooth in the specimens examined is 0·9 to 1·3 times longer than wide, and the ventral tooth may either be very small, wedge-shaped, and not visible from above or it may be much larger and extend anterior to the dorsal tooth. Mentum with coarse punctures bearing long, yellow hairs. Sixth and seventh segments of antenna feebly tuberculate; club 1·0 to 1·2 times wider than deep.

Pronotum very convex; about 2·3 times wider than head and 1·5 times wider than long; front angles small and obtuse; remainder of anterior margin slightly convex; hind angles very variable, obtusely rounded to acutely spiniform; remainder of posterior margin convex; sides very prominently obtusely angular near the middle, serrated, and with the anterior half produced into a brim which is reflected in some specimens. There is a conspicuous fringe of long, fulvous setae on the posterior margin of the pronotum. Scutellum broadly rounded apically, wider than long and with coarse punctures bearing long, appressed setae.

Elytra together about 1·2 times wider than pronotum; shoulders and sutural margin slightly raised. Each elytron has three or four prominent broad ridges formed by deep striae which extend from the base for about two-thirds the length of the elytron; near the middle of the elytron smaller, lower ridges alternate with

the main ridges. There is a small rounded protuberance near the distal extremity of the elytron.

Mesosternum with or without a narrow tubercle between the anteromedial edges of the second coxae. Metasternum with a shallow, median canal.

Legs covered with yellow setae; anterior tibia very wide distally, inner edge concave, outer edge strongly flattened and with four to seven teeth which are small near the proximal end of the segment and become progressively larger distally; outer edge of middle tibia with two to six simple or serrated spines which are smallest near the proximal end; outer edge of hind tibia with two to four simple spines; first through fourth tarsomeres with setae that are mainly marginal.

MALE

Length (with mandibles), 20·0 to 27·0 mm.; (without mandibles), 19·0 to 25·5 mm.: breadth, 10·0 to 12·5 mm.

Fifth abdominal sternite 5·8 to 6·2 times wider than long; distal margin truncate to slightly convex.

Male Genitalia (Figs 97–101). Penis slender. Basal piece cylindrical and with its proximal, dorsal half membranous. Parameres somewhat cylindrical; separated from the basal piece dorsally but continuous with it ventrally. Struts short; deep dorsoventrally. The eversible internal sac is about 4·5 times longer than the penis within which it is greatly coiled. Because of the small size of the basal orifice it has not been possible for the writer to evert completely the internal sac using a syringe but its structure has been studied in a specimen in which the sac is drawn back through the basal orifice (see Fig. 98). The internal sac is composed of six distinct regions. In the position shown in Fig. 98 the proximal region, a–b, bears dense, short, conical scales (Fig. 99) internally. The region c–d bears scattered, colourless, flattened, serrated scales (Fig. 100) on its internal surface. The short transition zone, b–c, bears both types of scales. The region d–e is colourless and unarmed. The external surface of the region f–g bears scattered colourless, minute, conical scales (Fig. 101). The terminal region, g–h, is very strongly sclerotized, deeply pigmented, without scales, and terminates in a blunt hook through which the ejaculatory duct opens to the exterior. The ejaculatory duct appears to enter the internal sac at the position marked e in Fig. 98, although this is not completely clear in the specimens examined. When the sac is in repose the tips of the scales are directed towards the ostium which is terminal.

Ninth abdominal segment as in Fig. 102; median sclerotized band broad.

FEMALE

Length (with mandibles), 20·0 to 29·0 mm.; (without mandibles), 19·0 to 27·5 mm.: breadth, 10·0 to 13·5 mm.

Terminal segment of labial and maxillary palps shorter than in male. Abdomen more convex ventrally than in male. Fifth abdominal sternite 4·6 to 5·5 times wider than long; distal margin convex.

Female Genitalia (Fig. 103). Styli 1·0 to 2·0 times longer than wide; somewhat claviform. Spermathecal duct strongly sclerotized, wide, and varying in length from six to 12 mm. in specimens of approximately the same total body length. Spermatheca strongly sclerotized, moderately deeply pigmented and not clearly marked off from spermathecal duct. In some specimens the spermatheca has fine, sclerotized ridges on its concave side and it also may be more curved than it is in the illustrated specimen. The duct of the spermathecal gland may have a small protuberance near its junction with the spermatheca.

Types of *earlii* White and *acutangulus* Arrow in the British Museum (Nat. Hist.).

Geographic variation.—Specimens from the same locality exhibit pronounced individual variation in total length and in the size of mandibular teeth and of projections on the head and thorax; it has not been possible to detect any trends in geographic variation.

Distribution.—This species occurs throughout New Zealand and has been collected from one outlying island (Mokohinau). There is no record of its having been collected from the Chatham Islands.

Biology.—These are fossorial beetles. Several years ago Dr R. K. Dell of the Dominion Museum observed adults of this species burrowing into a heap of turf that had recently been cleared from his garden. Several months later large lamellicorn larvae which were thought to be those of *D. earlii* were abundant in the heap of turf and seemed to be feeding on grass roots. According to Hudson (1934) this species flies at dusk during December.

Synonymy.—Arrow created *acutangulus* for a series of five specimens from Greymouth, New Zealand. He noted that the species was very similar to *earlii* but that it could be "easily distinguished from it (*earlii*) by the hind angles of the prothorax being produced into a sharp spine. Other differences are so slight as to be not easily appreciable." In a large series of specimens examined by the writer the shape of the hind angles of the pronotum is so variable that it cannot be considered to have any taxonomic significance. The minor differences listed by Arrow as being characteristic of *acutangulus* may also occur separately or together in specimens which have blunt hind angles on the pronotum, and they are not invariably present in specimens having sharp pronotal hind angles.

SPECIMENS EXAMINED

NORTH ISLAND.—AUCKLAND: 1 ♂, 1 ♀, Mokohinau I., no other data (DM). 1 spec., Manukau, 20.XII.1915, T. Broun Dup. Coll. (PDD). 1 ♂, Papakura, 18.II.1942, C. E. Clarke (PDD). 1 ♂, Paparimu, 9.XI.1928, A. Richardson (AM). 1 spec., Okauia, 5.V.1922, coll.? (PDD). 1 spec., Okauia, —.XII.1921, A. E. Brookes (PDD). 1 ♀, Oio, 20.I.1936, F. Gardner (EG). 1 spec., Taupo, no date, T. Broun Dup. Coll. (PDD). HAWKE'S BAY: 1 spec., Makotuku, —.II.1919, A. E. Brookes (PDD). WELLINGTON: 1 ♀, Ohakune, 20.XI.1919, M. Harris (AM). 1 spec., Ohakune, 30.XII.1931, E. Fairburn (PDD). 1 ♀, Ohakune, —.XII.1928, coll. ? (DM). 1 ♀, Erua, 30.XII.1940, C. E. Clarke (AM).

1 ♂, 6 ♀, Kariori, —.II.1937, coll. ? (CM). 1 ♂, 11 ♀, Karioi (2,000 ft), 4.II.1930, G. B. Rawlings (EG). 1 ♀, National Park, 24.XII.1939, A. Richardson (AM). 1 ♀, Ketetahi, 3.XII.1938, G. B. Rawlings (EG). 2 ♂, Levin, 24.XI.1909, A. C. O'Connor (DM). 1 ♀, Levin, —.XI.1909, A. C. O'Connor (DM). 1 ♀, Melling, 31.X.1954, R. K. Dell (DM). 1 ♀, Melling, 2.I.1958, R. K. Dell (DM). 1 ♀, Melling, 7.XII.1958, R. K. Dell (DM). 1 ♀, Taita, 12.I.1959, Mr Coleman (DM). Holotype, Hutt River, Port Nicholson, no date, Mr Earl (BMNH). 1 ♂, Karori, 11.XII.1947, J. T. Salmon (DM).
SOUTH ISLAND.—NELSON: 1 ♀, Nelson, 1940, E. S. Gourlay (AM). 1 ♀, Buller, 7.XII.1938, J. T. Salmon (DM). WESTLAND: 4 specs. (including type of *acutangulus*), Greymouth, no date, Helms (BMNH). OTAGO: 1 ♂, Ben Lomond, —.I.1923, G. Howes (AM).

There is a large series of specimens in the British Museum (Nat. Hist.).

DORCUS MACLEAY

Dorcus Macleay, 1819, *Horae Entomologicae*, p. 111. Type species: *Scarabaeus parallelipipedus* Linn. (virtually monobasic). (Macleay originally included a second species, *D. tuberculatus* Macleay, in *Dorcus* with a query but this proved to be synonymous with *parallelipipedus*.)

For the complete synonymy of this genus see Arrow (1950), pp. 77–78.

Range.—Almost world-wide.

Arrow (1950) pointed out that, at the present time, *Dorcus* is a composite genus. Undoubtedly it will be divided into a number of genera or species groups when the species at present included in it are more thoroughly studied. The essential characters of *Dorcus* are the partially but never completely divided eye, the three-segmented antennal club, and the hooked lacinia which is present only in females. Sexual dimorphism is very pronounced in most species, and allometry of the head and thorax in males is usually very striking. Allometry has been responsible for much of the taxonomic confusion existing in this complex, since many of the genera which previously were thought to be distinct from *Dorcus* were based on a few striking characters that are restricted to large males of particular species (see Arrow, 1935, 1950) and have been shown to have no generic value. Arrow (1950) considers that the most natural classification of the group will be based upon the more constant characters of females but the present writer is of the opinion that the genitalia of both males and females will provide the most satisfactory characters for indicating the interrelations of the species.

In the New Zealand species of *Dorcus* the genitalia are very uniform intraspecifically, even in species which exhibit pronounced allometry of other structures. The New Zealand species also show considerable interspecific uniformity in the structure of both male and female genitalia, and genitalia of these species are very different from those of the *Dorcus* type species (see Holloway, 1960) and from the genitalia (male only) figured by Didier (1937) for several other

species of *Dorcus*. It is clear that the *Dorcus* species from New Zealand constitute a distinct group, but there seems little point in giving the group the rank of genus when the relationships of the remaining species of *Dorcus* are so incompletely known.

Dorcus is represented in the New Zealand region by six species. They are dark brown or black beetles in which sexual dimorphism is marked and in which allometry of males is very pronounced. The group includes the largest New Zealand lucanid, *D. helmsi* (Sharp), some males of which attain a total length (including mandibles) of 39·0 mm., although the smallest males of this species are only 18·0 mm. long. The largest females are always considerably smaller than the largest males of the same species. Females have simple mandibles that exhibit few interspecific differences. In males the mandibles are massive and ornate, and usually provide diagnostic characters for separating the species. Allometric growth is pronounced in males of most species and produces considerable variation in the puncturation of the dorsal surface and in the relative size of mandibles, pronota, anterior tibiae, eyes, and tubercles on the head. In general, small males differ from large males of the same species in having shorter, broader mandibles, shorter anterior tibiae, smaller tubercles on the head, larger eyes, narrower pronota, and coarser, denser punctures on the head and pronotum. In both males and females the body is flattened and somewhat parallel-sided but females are less flattened dorsally and more convex laterally than are males. The vestiture and puncturation of the elytra are approximately the same for both sexes of a given species but, in general, the puncturation of the heads and pronota of females and small males is coarser and denser than that of large males of the same species.

The head is broad and wedge-shaped. The anterior margin is not rimmed; the middle third is truncate or slightly emarginate with a shallow concavity on either side. The eyes are small and partially divided by a canthus; eyes of females are larger than those of males of the same species. The labrum is short, broad, directed anteroventrally, and has a fringe of yellow setae around the margin. The mandibles are porrect, asymmetrical, capable of interlocking, and lack hairs except on the wide medial lobe at the base. Mandibles of males of most of the New Zealand species are long, slender, and ornately toothed; those of females are small, broad, and have simple teeth. The maxillae of *D. helmsi* shown in Figs 12 and 13 are more or less typical of those occurring in all the New Zealand species; in males the sclerotized point on the lacinia extends well beyond the middle of the galea. As many as 10 very small hooklets are present below the lacinial hook of females of *D. novaezealandiae* (Hope), but in all other females and in all males these hooklets are absent. In females of *D. novaezealandiae* and in males and females of *D. capito* (Deyrolle) several small hooklets may be present on the galea; they do not occur in the other New Zealand species. The galea is from two to three times longer than wide; the second segment of the maxillary palp is 1·2 to 2·1 times longer than the third and the terminal segment varies intraspecifically from long and slender to short and dilated. The labium of *D. helmsi* shown in Fig. 17 is typical of the New Zealand species group. The

mentum is much wider than long, emarginate or convex distally; the punctures on its external surface are coarse and dense in females and small males, finer and sparser in large males. The ligula is about half the length of the labial palp. The first segment of the labial palp is 2·6 to 3·6 times longer than the second, this measurement varying a great deal intraspecifically; the terminal segment of the labial palp is 2·1 to 3·8 times longer than wide and the proportions tend to be constant within each species.

The antennae are geniculate (Fig. 1); scape slender, slightly curved, and about half the length of the entire antenna; club composed of three broad, stout segments which bear setae on at least half of their external surface and are capable of being opposed. In some species the fourth through seventh antennal segments have a rounded or conical protuberance on the medial edge.

The pronotum is not tuberculate; the front angles vary interspecifically from being acute to obtuse, and are never prominent; in most New Zealand species the anterior margin except for the middle third is rimmed; the hind angles are obtuse; sides of pronotum narrowly rimmed, slightly obtuse-angled near the middle. Scutellum wider than long, clearly visible between elytra; the shape varies considerably intraspecifically. Elytra widest near the middle; sides produced into a reflected brim which has a narrow rim. Hindwings vestigial. Pro- and meso-sternal processes broad. Fifth abdominal sternite convex distally and similar in both sexes.

Legs long and slender; those of females and small males shorter and stouter than those of large males. Procoxal process absent (Fig. 7). Femora with dense, coarse or fine punctures bearing setae and scales. Tibiae with approximately seven longitudinal, shallow grooves bearing setae and scales; outer edge of middle and hind tibiae moderately convex, with or without a few spines near the middle, and with two to six teeth distally; fore tibia with one large conical spur; middle and hind tibiae each with one large and one small spur distally, the spurs conical or spatulate depending on the species.

MALE GENITALIA

The New Zealand species of *Dorcus* are characterized by having a permanently everted internal sac which terminates in a spoon- or cup-shaped structure on which the gonopore is located. A flagellum is not present. In some species there is one sclerite or a pair of sclerites near the gonopore. The penis rests on the distal end of the basal piece and is approximately as long as the parameres; it is strongly sclerotized ventrally, almost completely membranous dorsally, and is approximately cylindrical in shape. The permanently everted internal sac is about as long as the tegmen, feebly sclerotized, colourless or pale brown in colour, and most of its surface is covered with dense, short, simple spines which have their tips directed toward the distal end of the sac; when in repose the sac lies beneath the ninth abdominal sternite. The shape of the permanently everted internal sac is diagnostic for each species. Basal orifice broad. A pair of slender struts articulating on the proximal end of the penis lies within the basal piece. Tegmen moderately strongly sclerotized and pigmented, and composed of a basal

piece and a pair of long, leaf-like parameres connected to the basal piece by a very flexible membrane. The distal margin of the paramere is setose. Basal piece sclerotized ventrally and laterally but almost completely membranous dorsally.

The ninth abdominal segment of the New Zealand species of *Dorcus* characteristically has a shallow, median notch on the ventral, distal edge. This segment is moderately strongly sclerotized and about 1·1 times longer than the tegmen; dorsal surface without setae; ventral surface with long setae near the distal margin and with short, dense setae elsewhere.

FEMALE GENITALIA

The presence of a large, saccate, longitudinally-folded bursa copulatrix, a distinct bursal duct, and an accessory gland opening directly into the vagina distinguishes the New Zealand species of *Dorcus* from all other endemic species, and from the *Dorcus* type species in which there is no separate bursa copulatrix (see Holloway, 1960). The hemisternites are strongly sclerotized and pigmented, and each bears at its tip a small, setose stylus. The styli exhibit a large amount of intraspecific variation in shape and size. The spermatheca is small, elongate, curved, moderately strongly sclerotized and pigmented, and has no annulations on its walls. The spermathecal gland is bulbous or slightly elongate, very feebly sclerotized, and usually has a short but distinct duct that enters the spermatheca basally. The bursa copulatrix is very feebly sclerotized and is capable of considerable expansion. The spermathecal duct is short and feebly sclerotized in most species, and opens into an extension on one side of the bursa copulatrix. Bursal duct short, broad, and feebly sclerotized. There is a large, soft, colourless accessory gland opening into the vagina near the level of entry of the median oviduct.

Below is a list of the New Zealand species of *Dorcus* recognized in the present revision, together with a list of newly established synonymy. All these species formerly have been referred to *Lissotes* (see Roon, 1910; Didier and Séguy, 1953; Benesh, 1960).

auriculatus (Broun)

capito (Deyrolle)
= *Lissotes desmaresti* Deyrolle
= *Lissotes dispar* Broun

helmsi (Sharp)
= *Lissotes aemulus* Broun

ithaginis (Broun)

novaezealandiae (Hope)
= *Dorcus abditus* Broun

philpotti (Broun)

SPECIES EXCLUDED FROM *Dorcus* IN THE PRESENT STUDY

planus Broun
= *Lissotes planus* (Broun)

stewarti Broun
= *Lissotes stewarti* (Broun)

KEY TO THE NEW ZEALAND SPECIES OF *Dorcus* (MALES)

(1)	Head with a very deep, saucer-shaped depression between the eyes	*novaezealandiae* (Hope), p. 22
	Head usually flattened or slightly convex between the eyes and, if concave, never with a saucer-shaped depression	2
(2)	Anterior tibia strongly arcuate and with a long, curved spine at the distal extremity (see Fig. 35)	*philpotti* (Broun), p. 30
	Anterior tibia not strongly arcuate and never with a long, curved spine distally	3
(3)	Margin of head with two small projections behind each eye	*ithaginis* (Broun), p. 32
	Margin of head with one small or large projection behind each eye	4
(4)	Margin of head not produced into a horizontal lamina in front of each eye	*auriculatus* (Broun), p. 35
	Margin of head produced into a horizontal lamina in front of each eye	5
(5)	Dorsal integumental surface immediately behind eye hollowed out so that an approximately horizontal lamina is formed; terminal segment of maxillary palp 3·6 to 3·8 times longer than wide	*capito* (Deyrolle), p. 37
	Dorsal integumental surface immediately behind eye not hollowed out; terminal segment of maxillary palp 2·3 to 2·9 times longer than wide	*helmsi* (Sharp), p. 26

KEY TO THE NEW ZEALAND SPECIES OF *Dorcus* (FEMALES)

(1) Medial, dorsal edge of mandible with a long, *conical* tooth near the middle (see Fig. 38) .... *ithaginis* (Broun), p. 32

Medial, dorsal edge of mandible never with a long, *conical* tooth near the middle 2

(2) Postocular margin of head not angulate; head wider preocularly than at the eyes; head with a deep, saucer-shaped depression between the eyes; canthus extending at least half the length of the eye *novaezealandiae* (Hope), p. 22

Species not having this combination of characters 3

(3) Head distinctly widest and angulate postocularly; cuticle hollowed out immediately in front of eye; anterior half of elytron with a broad rim laterally .... *auriculatus* (Broun), p. 35

Species not having this combination of characters 4

(4) Head distinctly widest and angulate near the middle of the eyes; postocular margin of head without angulations; larger spur of hind tibia spatulate and not more than 3·5 times longer than wide ..... *helmsi* (Sharp), p. 26

Species not having this combination of characters 5

(5) Proximal third of anterior tibia constricted (see Fig. 36); elytra with narrow longitudinal bands of fine punctures alternating with broad bands of coarse punctures ..... *philpotti* (Broun), p. 30

Proximal third of anterior tibia not constricted; elytra more or less uniformly covered with small punctures .... *capito* (Deyrolle), p. 37

Dorcus novaezealandiae (Hope) n.comb.

Frontispiece, 5, 6

Figs 22, 23, 104, 109, 114, 120, 121

Lucanus Novae Zealandiae Hope, 1845, *Catal. Lucan.*, p. 25; female; original description. Type locality: New Zealand.

Dorcus punctulatus White, 1846, *Voy. Erebus and Terror. Insects,* p. 9; male; original description. Type locality: Wellington, New Zealand.

Sclerostomus caviceps Westwood, 1855, *Trans. ent. Soc. Lond.*, new series, 3: 212–213; pl. 12, figs 6, 7; male, female; original description. Type locality: New Zealand.

Lissotes Novae Zealandiae (Hope), Parry, 1873, *Trans. ent. Soc. Lond.*, p. 340.

Dorcus abditus Broun, 1881, *Man. N.Z. Coleopt.*, pt. 2: 673–674; male; original description. Type locality: New Zealand. NEW SYNONYMY.

The circular depression in the middle of the vertex and the small body size are sufficient to distinguish this from all other New Zealand species of the genus.

Body small to moderately large, and dull to glossy. Dorsal surface and ventral surface except for part of prosternum more or less uniformly covered with dense, coarse, circular punctures, those on the dorsal surface bearing very short, erect, brown scales which are easily abraded, those on the ventral surface bearing appressed or decumbent, short setae or scales.

Head (Figs 22, 23) with a deep, circular concavity between the eyes and with a small concavity in front of each eye; preocular margin obtusely rounded and without a rim; canthus extending more than half the length of the eye; frontal tubercle prominent, approximately conical. Distal margin of labrum truncate except for a median tubercle which interrupts a submarginal row of long setae. Mandibles densely punctured, the punctures near the base coarse and bearing short scales, those near the apex smaller and without vestiture. Seventh antennal segment not produced into a tubercle; antennal club 1·7 to 1·9 times wider than deep.

Pronotum with the front angles almost right-angled; anterior margin convex; posterior margin truncate or slightly convex; sides very obtusely angulate near the middle. Scutellum obtuse- or right-angled apically and about 1·3 times wider than long; with dense, coarse punctures bearing short, yellow, decumbent scales.

Each elytron with a moderately deep sutural ridge and traces of three or four other longitudinal ridges.

Part of prosternal process between coxae slightly concave and with dense, moderately coarse punctures bearing appressed scales; part behind coxae slightly convex, without a tubercle, and with sparser punctures which bear suberect scales; sides of prosternum with fine, moderately sparse punctures bearing narrow, appressed scales. Mesosternum slightly convex between coxae. Meso- and meta-

sterna with setae and fine scales. Abdominal sternites with appressed or decumbent setae and narrow scales; fifth abdominal sternite 2·3 to 2·8 times wider than long.

Fore and middle legs approximately equal in length, shorter than hind legs; femora with coarse punctures bearing setae and fine scales; tibiae with long setae and in some specimens with a few scales; hind tibia longest; middle tibia shortest; inner edge of anterior tibia uniformly concave; outer edge of middle and hind tibiae with or without a spine near the middle; tibial spurs slender and conical; arolium with two bristles.

MALE

Length (with mandibles), 12·1 to 19·7 mm.; (without mandibles), 10·5 to 16·9 mm.: breadth, 5·3 to 8·3 mm.

Head widest behind the eyes in large specimens, widest near the middle of the eyes in small specimens; concavity between the eyes very deep, smooth, and regular in outline; canthus almost completely dividing eyes; postocular margin obtusely angulate, very prominent in large specimens. Labrum 2·1 to 2·3 times wider than long. Mandibles large and stout; there is a considerable amount of individual variation in the size and shape of the teeth, and there are differences resulting from allometry and wear. Each mandible has a large, apical tooth directed inwards and two large, approximately horizontal teeth on the medial edge. Immediately behind the apical tooth a strongly allomorphotic, dorsal tooth extends upwards then inwards; in large males this tooth is long and bifurcate; in small males it is short and entire. Between this tooth and the base of the mandible a small, vertical, elongate tooth which exhibits a large amount of individual variation in form arises near the medial edge. All the teeth along the medial, ventral edge are capable of interlocking but the dorsal teeth are widely separated when the mandibles are closed. The apical tooth and dorsal tooth immediately behind it are greatly worn down in many specimens. Lacinial point extending for more than half the length of the galea; fourth segment of maxillary palp about 3·0 times longer than wide. Mentum shallowly emarginate, 2·0 to 2·2 times wider than long, with long setae on the distal margin, elsewhere with short setae arising from coarse punctures; third segment of labial palp 2·3 to 2·5 times longer than wide.

Pronotum 1·3 to 1·5 times wider than long and 1·1 to 1·3 times wider than head; front angles distant from eyes; anterior margin convex and strikingly allomorphotic, the middle third extends only as far forward as the front angles in small specimens but in large specimens it extends anterior to the front angles and overhangs the depression between the eyes; sides strongly deflected. In very large specimens the punctures are sparse near the anterior edge of the pronotum. Elytra together 1·0 to 1·1 times wider than pronotum. Outer edge of anterior tibia with seven to 14 teeth.

Male Genitalia (Fig. 104). Permanently everted internal sac flattened from side to side and expanded distally into a very soft, transparent cup which is produced further on the ventral than on the dorsal side. The gonopore is a very

small opening near the distal margin of the cup, in the middle and on the ventral side. Struts slightly more than half the length of basal piece. Parameres greatly expanded ventrally with very thin and translucent cuticle. Ninth abdominal segment as in Fig. 109.

FEMALE

Length (with mandibles), 12·0 to 15·8 mm.; (without mandibles), 10·9 to 14·6 mm.: breadth, 5·2 to 7·2 mm.

Head widest near the middle of the eyes; concavity between the eyes shallower, more irregular in outline and with a rougher surface than in male; canthus extending about two-thirds the length of the eye; postocular margin more or less straight except for a small convexity immediately behind eye. Labrum 1·9 to 2·0 times wider than long. Each mandible with a strong, apical tooth directed inwards and a small, subapical, ventral tooth; right mandible with a small, subapical, dorsal tooth. Lacinia with approximately ten small hooks; galea with one small hook; fourth segment of maxillary palp about 2·3 times longer than wide. Mentum truncate or feebly emarginate, about 1.4 times wider than long, coarsely and densely punctate, and with a few setae which are mainly marginal; third segment of labial palp approximately 1·8 times longer than wide.

Pronotum 1·4 to 1·5 times wider than long and 1·6 to 1·7 times wider than head; front angles extending forward at least to the posterior margin of the eyes; anterior margin slightly convex; sides with a narrow brim. Outer edge of anterior tibia with six to ten teeth.

Female Genitalia (Figs 114, 120, 121). Styli not very variable in shape; 1·0 to 1·2 times longer than wide; internal angle right-angled or obtuse; external angle acute or obtuse; distal margin truncate or with an obtuse projection near the middle. Spermathecal duct moderately long. Free margin of ninth abdominal tergite convex.

Type female and paratype female in the Hope Collection, Oxford University; types of *punctulatus* White and *abditus* Broun in the British Museum (Nat. Hist.); location of type of *caviceps* Westwood unknown.

Geographic variation.—Not determined.

Distribution.—This species appears to be very limited in its distribution, specimens so far having been collected only within a 35 mile radius of Wellington city.

Biology.—Hudson (1934) states that this species occurs under scaly bark of rimu trees (*Dacrydium cupressinum* Lamb.) at and below ground level, and under bark of living beech trees (*Nothofagus*). Specimens are sometimes found in well-decayed beech stumps, but in the writer's experience they are most abundant in fibrous leafmould and fern roots at the bases of beech trees, especially of *Nothofagus solandri* Oerst. Field observations on the feeding habits of *novae-zealandiae* have not been made but exuding sap has often been noticed under the loose beech bark near where the beetles occur. In captivity this species will feed on pieces of apple. Pairs (males and females) often are collected together

in the field and it seems highly likely that both sexes work together in making oviposition galleries in decaying wood. The head of the male, with the large depression between the eyes and the dorsoventrally deep mandibles, is well suited as a scoop for removing debris from tunnels. In some specimens large particles of organic material have been found adhering to the dorsal surface of the head. The writer has observed males in captivity using the mandibles to lift up small pieces of wood and to overturn other males that happen to be obstructing their paths. No fighting between males has been observed. Two teeth on each mandible of the male may show wear. These are the apical tooth and the large dorsal tooth behind it; the latter tooth has the anterior lobe completely worn off in some specimens, but the posterior lobe never appears to be worn. The head of the female is much less adapted as a scoop; the depression between the eyes is much smaller and shallower, and the mandibles are small and simple. The mandibular teeth of females examined by the writer show no discernible wear. Adults of this species occur throughout the year. In mid-October, 1958 a pair of specimens was observed in copulation amongst fibrous leafmould at the base of a beech tree at Days Bay, Wellington. During copulation the beetles stood in the same plane, facing opposite directions, with the distal ends of the elytra of one beetle touching those of the other.

Synonymy.—The writer has not seen the type of *caviceps* Westwood but the illustrations and original description clearly indicate that it is a specimen of *novaezealandiae*. The types of *abditus* Broun and *punctulatus* White have been examined by the writer who considers them to fall well within the range of variation of *novaezealandiae*.

SPECIMENS EXAMINED

NORTH ISLAND.—WELLINGTON: 1 ♂, Western Lake Road Reserve, Wairarapa, 13.IX.1960, R. G. Ordish (DM). 1 ♀, Lake Pounui, Wairarapa, 13.IX.1960, B. A. Holloway (DM). 1 ♀, Akatarawa, 6.II.1953, M. Redington (DM). 3 ♂, Silverstream, 26.VI.1910, A. C. O'Connor (DM). 3 ♀, Silverstream, 31.X.1909, A. C. O'Connor (DM). 1 ♂, Mt. Matthews, 8.II.1930, E. A. Plank (DM). 1 ♂, Gollans Valley, 8.XII.1923, T. Cockcroft (AM). 2 ♂, Gollans Valley, 7.I.1943, under scales of rimu bark, J. T. Salmon (DM). 1 ♀, Gollans Valley, 24.XII.1919, under scales of matai bark, G. V. Hudson (DM). 1 ♂, 1 ♀, Butterfly Creek, 16.XI.1958, S. V. Bandsma (DM). 6 ♂, 5 ♀, Days Bay, 15.XI.1953, R. G. Ordish (DM). 1 ♂, 1 ♀, in cop., Days Bay, 16.X.1958, R. G. Ordish (DM). 4 ♀, Days Bay, 16.X.1958, R. G. Ordish and B. A. Holloway (DM). 1 ♀, Korokoro, 28.IX.1939, G. V. Hudson (DM). 4 ♂, 1 ♀, Wellington, no date, Lewis Coll. (DM). 1 ♀, Wellington, 1900, coll.? (AM). 1 ♂, Wellington, 1923, G. V. Hudson (AM). 1 ♀, Wiltons Bush, 15.III.1942, E. S. Gourlay (EG). 3 ♂, Wiltons Bush, 13.III.1943, G. V. Hudson (DM). 1 ♀, Karori, 22.XI.1941, R. R. Forster (DM). 1 ♀, Karori, 3.VIII.1941, R. R. Forster (DM). 1 ♂, 2 ♀, Happy Valley, 3.III.1941, R. R. Forster (PDD). 5 ♀, Happy Valley, 23.VIII.1941, R. R. Forster (DM).

Dorcus helmsi (Sharp) n.comb.

Frontispiece, 2–4

Figs 1, 7, 12, 13, 17, 24–31, 105, 110, 116, 122, 123

Lissotes Helmsi Sharp, 1881, *Ent. mon. Mag.,* 18: 49; male; original description. Type locality: Greymouth, New Zealand.

Lissotes aemulus Broun, 1893, *Man. N.Z. Coleopt.,* pt. 5: 1109; female; original description. Type locality: Boatman's, near Reefton, New Zealand. NEW SYNONYMY.

Lissotes acmenus Lewis, 1902, *Trans. Proc. N.Z. Inst.,* 34: 203; male; original description. Type locality: Invercargill, New Zealand.

Females of *helmsi* are best distinguished from those of other New Zealand species by the head being distinctly widest and angulate near the middle of the eyes, by the postocular margin lacking angulations, and by the unconstricted anterior tibia. Males exhibit striking allometry; they can be distinguished from those of other species by the form of the head and mandibles described below. There is a close resemblance between males of *helmsi* and *philpotti,* but *helmsi* is easily distinguished by its non-curved anterior tibia.

Body small to very large, and dull to glossy. Dorsal surface of head and pronotum moderately to very densely punctate, the punctures fine to coarse but of approximately uniform size in any one specimen; if coarse they usually bear a short, erect scale; if fine they are naked. Each elytron usually with five longitudinal, narrow bands of fine punctures alternating with broad bands of coarse punctures; all the punctures bear erect yellowish brown scales. Clothing and puncturation of ventral surface variable and described below.

Head (Figs 24, 28) shallowly hollowed out immediately in front of eyes; preocular margin with or without a rim; canthus extending less than half the length of the eye; frontal tubercle moderately prominent, conical or wedge-shaped. Labrum 1·6 to 2·4 times wider than long, relatively widest in large specimens; distal edge uniformly rounded, or truncate and with a small, median protuberance surrounded by long setae. Galea and lacinia without small hooks. Mentum with coarse, dense punctures bearing narrow scales. Seventh antennal segment prominently produced medially but not tuberculate; antennal club 1·5 to 1·7 times wider than deep.

Pronotum with the front angles obtuse- or right-angled; posterior margin slightly convex; sides obtusely angulate near the middle with the margin reflected. Scutellum obtusely rounded or truncate apically and 1·6 to 2·2 times wider than long; with a few fine punctures bearing appressed scales and setae.

Each elytron, in general, with five longitudinal bands of fine punctures bearing long scales alternating with broad bands of coarser punctures bearing short scales. ment of the punctures. In the material examined longitudinal elytral bands are The scales tend to split longitudinally and may have the appearance of tufts of setae. In abraded specimens the elytral bands can be identified from the arrange-

present in all specimens except one from Karamea and one from Riverton; the Karamea specimen is small and its elytra are uniformly coarsely and densely punctured; the Riverton specimen is large and its elytra are uniformly sparsely and finely punctate.

Prosternal process very variable, concave to tuberculate between coxae, flattened to very convex behind coxae; puncturation very variable, most often coarse and dense in small specimens and fine and sparse in large specimens. Mesosternum slightly to prominently convex between coxae. Fifth abdominal sternite 2·7 to 3·0 times wider than long; densely and coarsely punctate, and with short decumbent scales. The remainder of the ventral surface exhibits much individual variation in puncturation but is never very densely or coarsely punctate.

Femora with coarse punctures bearing scales or setae; middle tibia shortest; inner edge of anterior tibia more or less uniformly concave; outer edge of middle tibia with a spine near the middle; hind tibia with or without a spine near the middle; middle and hind tibial spurs broad and spatulate; arolium with three to seven bristles.

MALE

Length (with mandibles), 18·0 to 39·0 mm.; (without mandibles), 15·5 to 31·0 mm.: breadth, 7·7 to 17·0 mm.

In small specimens the dorsal surface of the head and thorax tends to be densely and coarsely punctate; in large specimens the punctures tend to be finer and sparser. Head widest behind the eyes; frontal depression shallow, smooth and extending beyond the posterior margin of the eye; outer edge of eye straight in large specimens, convex in small specimens; postocular margin with an acute- or obtuse-angled projection which is flattened on the underside and is least prominent in small specimens. Dorsal surface of labrum flattened and with scattered fine punctures distally. Mandibles small, stout, and slightly curved in small specimens, long, slender, and strongly curved in large specimens; in large and small specimens finely and densely punctate. Figures 24 to 27 show the different forms of mandibles occurring in different-sized specimens. Each mandible has a strong, dorsal, apical tooth which is directed inwards in small specimens, inwards and upwards in large specimens. On the ventral surface near the middle of the mandible a large, strongly curved tooth is directed anteromedially; this tooth tends to be prominently bifurcated in small specimens, but in larger specimens the posterior arm of the bifurcation is indistinct or absent. A small tooth is present at the base of the bifurcated tooth, and a small tubercle may be present at the base of the apical tooth. In large specimens a shallow ridge extends from this tubercle to near the base of the mandible. When the mandibles are closed the dorsal and ventral teeth of the left mandible are in contact with and slightly anterior to the corresponding teeth of the right mandible. Maxilla (Fig. 12) with the lacinial point extending less than half the length of the galea; fourth segment of palp 2·3 to 2·9 times longer than wide, widest in large specimens. Mentum convex or shallowly emarginate distally, and 2·2 to 2·8 times wider than long; third segment of labial palp 2·3 to 3·7 times longer than wide, narrowest in small males. Antenna as in Fig. 29.

Pronotum 1·5 to 2·0 times wider than long and 1·0 to 1·2 times wider than head; front angles distant from eyes; middle third of anterior margin approximately truncate in small males, convex in large males. Elytra together 0·8 to 1·0 times the width of pronotum, relatively broadest in small males. Legs long and slender; anterior tibia as in Fig. 30, outer edge with five to 11 teeth; fore and hind tibiae about equal in length in small males; fore tibia much longer than hind tibia in large males.

Male Genitalia (Fig. 105). Generally resembling those of *novaezealandiae,* but differing in the following characters. The distal expansion of the permanently everted internal sac is much longer and more spoon-shaped, and is concave on the dorsal surface; near the distal edge of the convex surface the expansion forms a funnel which is split dorsally and ventrally at the midline. The gonopore is a small, oval aperture inside the funnel near the dorsal split. The right and left sides of the funnel are strongly sclerotized externally. The remainder of the permanently everted sac is shorter and less flattened than in *novaezealandiae.* Struts about 0·7 times the length of basal piece. Parameres much less extensive ventrally than in *novaezealandiae.* Ninth abdominal segment as in Fig. 110.

FEMALE

Length (with mandibles), 16·0 to 30·0 mm.; (without mandibles), 15·0 to 27·5 mm.: breadth, 7·8 to 14·0 mm.

The dorsal surface of the head and thorax is densely and coarsely punctate. Head widest at the eyes; frontal depression very shallow, irregular, and indefinite; outer edge of eye convex; postocular margin approximately straight. Dorsal surface of labrum flattened to strongly convex, and with scattered coarse punctures distally. Mandibles coarsely and moderately densely punctate; each with a large, apical tooth directed inwards, a small, subapical, ventral tooth and a small, dorsal tubercle medially near the base. Right mandible always, left mandible in some specimens, with a small, subapical, dorsal tooth. Maxilla (Fig. 13) with the fourth segment of the palp 3·3 to 3·7 times longer than wide. Labium as in Fig. 17; mentum 2·0 to 2·4 times wider than long; third segment of labial palp 2·3 to 3·0 times longer than wide. Second through seventh antennal segments less strongly produced medially than in male.

Pronotum 1·5 to 1·8 times wider than long and 1·4 to 1·5 times wider than head; front angles close to eyes; anterior margin approximately straight. Elytra together 0·9 to 1·1 times the width of pronotum. Fore and hind tibiae about equal in length; anterior tibia as in Fig. 31, outer edge with four to eight teeth.

Female Genitalia (Figs 116, 122, 123). Styli very variable in form; 0·9 to 1·4 times longer than wide; internal angle acute to obtuse; external angle obtusely rounded or sharply acute; distal margin slightly to prominently convex. Spermathecal duct short. Free margin of ninth abdominal tergite convex or truncate.

Type in the British Museum (Nat. Hist.); type of *aemulus* Broun also in the British Museum; location of type of *acmenus* Lewis unknown.

Geographic variation.—This species shows clinal variation in body size, smallest males and females occurring in the northern part of the range. Measurement of the head width of males throughout the range has yielded the following data: in nine specimens from Nelson Province and north Westland head width ranged from 6·7 mm. to 11·9 mm. with a mean width of 8·5 mm.; in 29 specimens from Otago and Southland head width ranged from 7·3 mm. to 15·8 mm. with a mean width of 11·0 mm.; in 16 specimens from the Stewart Island area head width ranged from 9·9 mm. to 16·1 mm. with a mean width of 13·2 mm. No other geographic variation has been detected.

Distribution.—*D. helmsi* has a peripheral distribution in the west and south of the South Island and it occurs also in the Stewart Island area. These are regions of very high rainfall. There are no records of this species being collected east of the Southern Alps farther north than Dunedin.

Biology.—According to Hudson (1934) the adults of *helmsi* are common at the base of trunks of kahikatea (*Podocarpus dacrydioides* A. Rich.). At Stewart Island the writer has observed adult beetles, sometimes in pairs, feeding at night on sap exuding from trunks of broad-leaved trees. Whether the beetles are able to make incisions in the trunk is not known; it is possible that they can since the morphologically very similar species, *Apterodorcus bacchus* (Hope) of Chile is known to cut the bark of beech trees to obtain sap (Ruiz, 1924). If this habit occurs in *helmsi,* and if males play any part in the cutting, one form of the strikingly allomorphotic mandibles could very easily be better suited to making the cuts than would another form. Nothing is known about the life cycle except that adults have been collected throughout the year.

Synonymy.—The writer has not seen the type of *acmenus* Lewis but the original description indicates that it falls well within the range of variation shown by *helmsi,* and Arrow (1935) also considered *acmenus* to be synonymous with *helmsi* after examination of *acmenus* topotypes. The type of *aemulus* Broun is a female with typical *helmsi* characters.

SPECIMENS EXAMINED

SOUTH ISLAND.—NELSON: 1 ♂, Cape Foulwind, 1922, R. S. Sutherland, A. E. Brookes Coll. (PDD). 5 ♂, 16 ♀, N. Karamea Beach, 3.III.1938, A. Richardson (AM). 2 ♀, same data (PDD). 2 ♂, 2 ♀, same locality and collector, 10.III.1939 (AM). 1 ♀, Kohiahia River, Karamea, 3.III.1938, A Richardson (AM). 1 ♂, same data (EG). 1 ♀, Inangahua, 10.III.1939, A. Richardson (EG). 1 ♀, same data (AM). 1 ♂, Oparara River, 8.XI.1940, E. S. Gourlay (EG). 1 ♀, Oparara, no date, A. Richardson (PDD). WESTLAND: 1 ♂, Mt. Greenland (2,000 ft), 1.XI.1940, E. S. Gourlay (EG). 1 ♂, Rimu, 25.VII.1931, G. B. Rawlings (EG). 1 ♂, Okarito, no date, Graham Bros. (DM). OTAGO: 2 ♂, 1 ♀, Catlins River, —.X.1940, G. Howes (AM). 1 ♂, Waihola, 29.III.1938, coll.? (CM). 1 ♂, 1 ♀, Otago, no date, G. Howes (DM). 6 ♂, Milford Sound, 19.XII.1944, under log, J. T. Salmon (DM). 2 ♂, same locality and collector, 14.XII.1944 (DM). 1 ♂, Milford Sound, 20.I.1946, coll. ? (DM). 1 ♀, Milford Sound, 7.I.1928, coll.? (AM). 1 ♂, Cleddau River, Milford Sound, 7.I.1928,

A. Richardson (AM). SOUTHLAND: 2 ♀, George Sound, 21.IV.1949, C. J. Lindsay (DM). 2 ♂, Stillwater River, 10.III.1949, C. J. Lindsay (DM). 1 ♂, 2 ♀, Caswell Sound, 22.III.1949. R. K. Dell (DM). 2 ♀, Leslie Clearing, 15.III.1949, R. K. Dell (DM). 2 ♂, Stillwater River, 11.III.1949, R. K. Dell (DM). 1 ♂, Doubtful Sound, no date, H. Odey (DM). 1 ♂, Worseley Arm, Lake Te Anau, 26.XII.1927, coll. ? (AM). 2 ♂, Lake Hauroko, —.I.1948, J. S. Hood (EG). 1 ♂, Longwood Range, Otautau, 9.III.1938, A. C. O'Connor (CM). 1 ♂, Longwood Range, Orepuki, 29.XII.1937, E. Sorensen (EG). 1 ♂, Longwood Range (1,000 ft), 18.XII.1959, J. H. Sorensen (DM). 1 ♀, Orepuki, 15.I.1944, C. E. Clarke (AM). 2 ♂, 2 ♀, Orepuki, 29.XII.1937, E. Sorensen (CM). 1 ♂, Orepuki, 9.V.1949, R. R. Forster (CM). 1 ♂, Orepuki, 17.V.1948, J. H. Sorensen (DM). 1 ♂, 1 ♀, Orepuki, —.X.1910, A. C. O'Connor (DM). 3 ♂, Bluecliff, 24.XII.1929, coll.? (AM). 2 ♂, Bluff, —.I.1945, A. Richardson (AM). 1 ♂, Bluff Hill, 30.I.1947, C. E. Clarke (AM). 2 ♂, Riverton, 18.I.1944, C. E. Clarke (AM). 1 ♂, same locality and collector, 20.I.1944 (AM). 2 ♂, 5 ♀, Pukemaori, Tuatapere, 25.VIII.1931, J. W. Bradley (EG). 1 ♂, Hump Mt., 1.I.1922, coll. ? (AM). 1 ♂, Westplains, —.I.1927, C. E. Clarke (EG).
STEWART ISLAND.—1 ♂, 1 ♀, Stewart I., 8.I.1947, C. E. Clarke (AM). 2 ♂, Oban, —.I.1945, A. Richardson (EG). 4 ♂, 1 ♀, same data (AM). 1 ♂, Horseshoe and Halfmoon Bays, 21–25.XI.1946, R. R. Forster (DM). 1 ♂, 2 ♀, Easy Cove, S.W. Stewart I., 25–26.I.1955, R. K. Dell and B. A. Holloway (DM). 3 ♂, Murderer's Cove, Big South Cape I., 1932, Major Wilson (DM). 1 ♂, Owen I., 29.I.1955, R. K. Dell and B. A. Holloway (DM).

Dorcus philpotti (Broun) n.comb.

Frontispiece, 7

Figs 32–36, 106, 112, 115, 124, 125

Lissotes philpotti Broun, 1914, *Bull. N.Z. Inst.*, 1: 103–104; male; original description. Type locality: Hump Ridge (3,000 ft), west of Tewaewae Bay, New Zealand.

Males and females of this species can be distinguished from those of the other New Zealand species of *Dorcus* by the form of the anterior tibiae. In males, the anterior tibia is strongly arcuate and has a large, curved spine distally on the inner edge. In females, the basal third of the tibia is constricted. This species is very similar to *helmsi*, but differs in the following characters.

Underside of thorax and abdomen more or less uniformly densely punctate, the punctures moderately coarse and bearing suberect or decumbent scales or setae.

Head (Figs. 32, 33) not depressed immediately in front of eyes; frontal tubercle less prominent than in *helmsi*; distal margin of labrum with a median and two lateral tubercles; fourth through seventh antennal segments prominently produced medially (Fig. 24).

Scutellum with coarser punctures and larger scales than in *helmsi*.

Prosternal process less variable than in *helmsi*; part between coxae flat; part behind coxae convex; punctures dense and coarse; sides of prosternum finely punctate. Mesosternum flattened or slightly convex between coxae. Meso- and meta-sterna with moderately large punctures which are fine near the midline but denser elsewhere. First through fourth abdominal sternites with coarse punctures which are sparse laterally but more or less uniformly dense elsewhere; fifth abdominal sternite with coarse punctures which are moderately dense proximally and bear short scales, but are very dense distally and bear long scales.

Outer edge of middle and hind tibiae with a small spine near the middle; middle and hind tibial spurs slender and conical except for the tips, which are slightly flattened; arolium with two to four bristles.

MALE

Length (with mandibles), 22·2 to 29·0 mm.; (without mandibles), 19·4 to 24·2 mm.: breadth, 9·0 to 12·2 mm.

Head depressed above base of antenna; postocular margin with an acute-angled projection which is much more prominent than in *helmsi,* and which is very concave on its anterior face. The specimens examined do not show the great range in body size that is seen in *helmsi,* and allometry of the mandibles is much less pronounced. The apical tooth and bifurcated ventral tooth of the mandibles are relatively longer than they are in *helmsi,* and the tooth near the base of the bifurcated tooth is larger. The tubercle and ridge which are present on the mandibles of equivalent-sized specimens of *helmsi* do not occur in *philpotti.* When the mandibles are closed, the apical and bifurcated teeth of the right mandible are in contact with and slightly below those of the left mandible. Fourth segment of maxillary palp 2·5 to 2·7 times longer than wide. Mentum 2·8 to 2·9 times wider than long; third segment of labial palp 2·7 to 2·8 times longer than wide.

Pronotum 1·8 to 2·3 times wider than long; middle third of anterior margin convex. Anterior tibia (Fig. 35) longer than hind tibia, and with three to five small teeth and two large teeth on the distal half of the outer edge.

Male Genitalia (Fig. 106). The distal expansion of the permanently everted internal sac is narrower and shorter than in *helmsi* and has a pair of prominent, asymmetrical, triangular lobes proximally. The remainder of the permanently everted sac is less flattened and more strongly sclerotized than in *helmsi.* The gonopore is on the ventral surface near the distal extremity of the everted sac; it is on a small papilla that is surrounded by a sclerotized ring which is split at the midline on the distal edge and is very strongly sclerotized on either side of the split. The edges of the gonopore are sclerotized and faintly pigmented. Ninth abdominal segment as in Fig. 112.

FEMALE

Length (with mandibles), 19·5 to 23·6 mm.; (without mandibles), 18·0 to 21·6 mm.: breadth, 8·8 to 11·9 mm.

Head widest at or immediately in front of eyes; frontal depression deeper than in *helmsi;* outer edge of eye almost straight. Dorsal surface of labrum slightly convex. Mandibles somewhat finely punctate and without a dorsal tubercle near the base. Fourth segment of maxillary palp 2·4 to 3·0 times longer than wide. Mentum 1·9 to 2·2 times wider than long; third segment of labial palp 2·1 to 2·4 times longer than wide.

Anterior tibia as in Fig. 36; proximal third prominently constricted; distal two-thirds with two large teeth and two to four small teeth along the outer edge.

Female Genitalia (Figs. 115, 124, 125). Styli very variable in shape; 1·1 to 1·7 times longer than wide; external and internal angles obtusely rounded or angular; distal margin truncate or rounded. Distal margin of ninth abdominal tergite rounded.

Type in the British Museum (Nat. Hist.).

Geographic variation.—No pattern discernible.

Distribution.—*D. philpotti* appears to be restricted to a small area west and north of Tewaewae Bay in Southland, where it is sympatric with *helmsi.*

Biology.—Nothing is known about the biology of this species.

SPECIMENS EXAMINED

SOUTH ISLAND.—SOUTHLAND: 1 ♂, 1 ♀, Lake Tauroko, —.I.1948, J. S. Hood (EG). 2 ♂, Mt. Cleughearn, Lake Monowai, —.II.1946, collected by deerstalkers (PDD). 1 ♀, Puysegur Point, 10.II.1922, A. E. Brookes Coll. (PDD). 1 ♀, Tewaewae Bay, 14.I.1944, C. E. Clarke (AM). 1 ♂, Hump Mt. (3,000 ft), 10.I.1941, C. E. Clarke (AM). 1 ♂, same locality and collector, 11.I.1944 (AM). 1 ♂, same locality and collector, 16.I.1944 (AM). 2 ♂, 2 ♀, Hump Mt. (4,000–4,250 ft), 19.I.1947, C. E. Clarke (AM). 1 ♂, 1 ♀, Hump Mt., 1.I.1922, coll. ? (AM). 1 ♀, The Hump, 23.XII.1915, A. C. O'Connor (DM). 1 ♂, same locality and collector, —.III.1919 (DM). The A. E. Brookes Coll. (PDD) contains a male specimen of *philpotti* collected at Seymour; the writer has been unable to locate this place.

Dorcus ithaginis (Broun) n.comb.

Frontispiece, 8, 9

Figs 37–40, 107, 111, 117

Lissotes ithaginis Broun, 1893, *Man. N.Z. Coleopt.*, pt. 5: 1108–1109; female, male (part); original description. Type locality: Halodroma Islet, Mokohinau Islands, New Zealand.

The presence of a long, conical, vertical, dorsal tooth near the middle of the mandible in both males and females distinguishes *ithaginis* from all other New Zealand species of *Dorcus*,

Body large and glossy. Dorsal surface of head and thorax differently punctured and clothed in males and females, and described below. Elytra uniformly densely and moderately coarsely punctate, some of the punctures bearing short, erect, brown scales. Ventral surface with moderately dense punctures which vary in size but are never coarse, and most bear fine, appressed or decumbent scales or setae.

Head (Figs 37, 38) widest behind the eyes; not depressed immediately anterior to each eye; preocular margin not elevated. Labrum weakly trilobed distally and with a few standing scales mainly on the distal half. Galea and lacinia without small hooks. Mentum with coarse, moderately dense punctures bearing short, erect scales; distal edge emarginate and fringed with long setae. Seventh antennal segment (Fig. 39) produced slightly on the medial edge; second through sixth antennal segments cylindrical; antennal club about 1·6 times wider than deep.

Pronotum with the front angles approximately right-angled, and very distant from the eyes; anterior and posterior margins convex in the middle; sides obtusely angulate behind the middle, and reflected. Scutellum obtuse-angled apically and about 2·7 times wider than long.

Elytra together 0·9 to 1·0 times the pronotal width; sutural margin slightly raised; remainder of elytral surface smooth except for about eight very fine, longitudinal striae which are discernible in some specimens.

Prosternal process between coxae flat and with moderately coarse, small punctures which bear appressed scales; part behind coxae produced into a large, conical tubercle which bears fine punctures and a few erect scales. Sides of prosternum with fine, dense punctures bearing short, decumbent scales. Mesosternum very convex between coxae. Meso- and meta-sterna with setae and scales, those near the middle of the metasternum sparse, the remainder dense. Punctures on first through fourth abdominal sternites sparse near the sides, denser elsewhere. Fifth abdominal sternite 2·4 to 2·8 times wider than long; with dense, long scales.

Femora with fine punctures bearing setae and scales; outer edge or anterior tibia with four or five teeth on the distal two-thirds; outer edge of middle and hind tibiae with a spine near the middle; tibial spurs slender and conical except for the tips which are slightly flattened; arolium with two or three bristles.

MALE

Length (with mandibles), 25·5 to 32·8 mm.; (without mandibles), 20·5 to 24·8 mm.: breadth, 10·4 to 12·4 mm.

Head very finely and moderately densely punctured, and naked except for a few short setae near the postocular margin; canthus extending less or more than half the length of the eye; frontal depression absent; frontal tubercle very small; postocular margin with a small projection near the eye and with a larger one near the pronotum. Labrum 2·4 to 2·7 times wider than long. Mandibles long, slender, arcuate, finely and sparsely punctate, and tridentate apically; two of the apical teeth approximately horizontal and directed medially, the third is dorsal

and approximately vertical; a long, conical, dorsal tooth arises near the middle of the mandible and extends upwards and slightly inwards. Lacinial point extending about half the length of the galea; fourth segment of maxillary palp approximately 4·1 times longer than wide. Mentum approximately 2·6 times wider than long; third segment of labial palp about 3·6 times longer than wide.

Pronotum 2·0 to 2·2 times wider than long and 1·0 to 1·2 times wider than head; punctures on posterior third dense, moderately large, and bearing short, erect scales; those on the remainder smaller, finer and naked. Scutellum smooth. Fore and hind tibiae about equal in length and longer than middle tibia; anterior tibia as in Fig. 40.

Male Genitalia (Fig. 107). Generally resembling those of *novaezealandiae* but differing mainly in the following characters. The cup-shaped expansion of the permanently everted internal sac is more distinct and is produced dorsally as well as ventrally; there is a small, semicircular, sclerotized ring in the middle of the ventral, distal edge of the cup. The gonopore is a small, median, pear-shaped aperture on the concave surface of the cup, a short distance from the sclerite. Struts about three-quarters of the length of basal piece. Parameres about half the length of tegmen and much less extensive ventrally than in *novaezealandiae*. Ninth abdominal segment as in Fig. 111.

FEMALE

Length (with mandibles), 20·0 to 22·5 mm.; (without mandibles), 18·0 to 20·5 mm.: breadth, 9·4 to 11·4 mm.

Head coarsely and densely punctate, and with a few erect, short scales; canthus less than half the length of eye; frontal depression irregularly concave; frontal tubercle large; postocular margin obtusely angulate or rounded. Labrum 2·1 to 2·4 times wider than long. Mandibles coarsely and densely punctate, and angulate externally near the base; apex bidentate with both teeth directed medially; the dorsal, vertical, conical tooth near the middle of each mandible is shorter than in the male. Fourth segment of maxillary palp about 2·4 times longer than wide. Mentum approximately 2·3 times wider than long; third segment of labial palp about 2·1 times longer than wide. Third through fifth antennal segments shorter and stouter than in male.

Pronotum 1·6 to 1·7 times wider than long and 1·4 to 1·5 times wider than head; punctures coarse, dense and bearing short, erect scales. Scutellum with a few fine punctures bearing decumbent scales. Fore and middle tibiae about equal in length and shorter than hind tibia; anterior tibia similar to that of the male except that the inner edge is slightly concave.

Female Genitalia (Fig. 117). Styli 1·2 to 1·5 times longer than wide; internal and external angles obtusely rounded; distal margin feebly convex. Spermathecal duct short. Ninth abdominal tergite rounded to slightly emarginate distally.

Type in the British Museum (Nat. Hist.). The fragments of the male referred to by Broun in the original description are not in his collection at the British Museum and probably were discarded after he obtained a complete male collected by Lewis in 1902.

Geographic variation.—The sample is too small and from too restricted an area for geographic variation to be detected.

Distribution.—This species has been recorded only from the Mokohinau Islands, 20 miles north-west of Great Barrier Island, New Zealand.

Biology.—In the original description Broun mentions that this species burrows through the peat-like layer formed by *Mesembryanthemum australe* Aiton.

SPECIMENS EXAMINED

MOKOHINAU ISLANDS.—Type ♀, Halodroma Islet, no date, coll. Sandager (BMNH). 1 ♂, Mokohinau Is., —.V.1902, J. H. Lewis (BMNH). 2 ♂, 2 ♀, Mokohinau Is., no date, P. Sandager (DM). 2 ♀, Mokohinau Is., no date, Lewis Coll. (DM). 1 ♀, no details (CI). 1 ♀, no details, T. Broun Duplicate Coll. (PDD).

Dorcus auriculatus (Broun) n.comb.

Figs 41–43, 118

Lissotes auriculatus Broun, 1903, *Ann. Mag. nat. Hist.*, (7) 11: 615–616; male; original description. Type locality: Thames, New Zealand.

The male of *auriculatus* is best distinguished from other New Zealand species by the form of the mandibles; they are bifurcate at the tips and have a large, vertical, bifurcate, dorsal tooth near the middle. The female differs from those of other New Zealand species in having the following combination of characters: mandibles without any projections near the middle of the dorsal surface; head widest behind the eyes (postocular margin strongly angulate).

Body large and moderately glossy. Puncturation and vestiture of dorsal surface of head and thorax differing in males and females and described below. Elytra with dense, coarse, circular punctures which bear erect, yellowish-brown, approximately truncate scales. Puncturation and vestiture of ventral surface irregular and descibed below.

Head (Figs 41, 42) widest behind eyes; surface not depressed immediately in front of each eye; preocular margin not elevated; canthus extending approximately half the length of eye; postocular margin with a large, obtuse-angled projection which is convex dorsally. Mentum coarsely and densely punctured, very shallowly emarginate distally, and with a few long setae. Second through seventh antennal segments cylindrical; antennal club approximately 1·3 times wider than deep.

Pronotum with the front angles distant from eyes; anterior edge slightly convex in the middle; sides obtuse-angled near the middle. Scutellum obtuse-angled apically, about 2·0 times wider than long, and with a few coarse punctures bearing setae.

Elytra together approximately 0·9 times the pronotal width; sides produced into a broad, reflected brim; elytral suture slightly elevated. On each elytron there are traces of four feebly elevated, longitudinal striae.

Prosternal process slightly convex between and behind coxae; part between coxae with coarse, dense punctures bearing appressed scales; part behind smooth except for a cluster of erect scales which arise from small punctures; sides of prosternum finely punctate and with short, decumbent setae. Mesosternum slightly convex between coxae, and with dense, fine punctures which bear appressed setae. Fifth abdominal sternite 2·5 to 2·7 times wider than long. Metasternum and abdominal sternites with dense, coarse punctures bearing short, decumbent scales.

Femora with coarse punctures and short, fine scales; legs all about the same length; middle and hind tibiae with a small spine near the middle; middle and hind tibial spurs slender and conical except for the tips which are slightly flattened; number of bristles on arolium unknown.

MALE

Length (with mandibles), 25·0 mm.; (without mandibles), 20·0 mm.: breadth, 11·5 mm.

Middle third of posterior half of head, and anterior fifth of pronotum (except sides) with sparse, fine, naked punctures; lateral margins and hind angles of pronotum with coarse, dense punctures which bear short, erect scales; remainder of head and pronotum with moderately dense, coarse punctures, some bearing short, erect scales. Anterior third of head prominently depressed; frontal tubercle small; postocular projection strongly concave ventrally. Labrum truncate and 3·0 times wider than long; with scattered, fine, naked punctures. Mandibles long, slender, arcuate, finely and densely punctate, bifurcate apically, with a large, bifurcate, dorsal, approximately vertical tooth near the middle of the mandible and with a small, conical, dorsal projection on the medial edge near the base of the mandible. Maxilla and labium not examined; mentum 2·6 times wider than long.

Pronotum parallel-sided on the anterior two-thirds, narrowing behind; 2·2 times wider than long and equal in width to the head; front angles acutely rounded. Anterior tibia as in Fig. 43.

Male Genitalia. Not examined.

FEMALE

Length (with mandibles), 20·1 mm.; (without mandibles), 18·4 mm.: breadth, 9·2 mm.

Head and pronotum with coarse, dense punctures which bear short, erect scales. Head with two small depressions between the eyes; frontal tubercle large; postocular projection convex ventrally. Labrum 1·6 times wider than long, and weakly trilobed distally; with scattered, large punctures bearing erect scales. Mandibles coarsely and densely punctate, with a prominent, apical tooth directed inwards and a small, rounded, subapical, ventral tooth; right mandible also with a blunt, subapical dorsal tooth. Galea and lacinia without small hooks; fourth segment of maxillary palp 3·0 times longer than wide. Mentum 2·1 times wider than long; third segment of labial palp 2·1 times longer than wide.

Pronotum 1·6 times wider than long and 1·5 times wider than head; front angles obtusely rounded; sides convex. Inner edge of anterior tibia uniformly concave; outer edge with six or seven teeth on the distal half.

Female Genitalia (Fig. 118). Styli club-shaped; length and breadth about equal. The spermathecal duct opens into the concave side of a cup-shaped protuberance near the middle of the bursa copulatrix. Spermathecal duct moderately long, broad basally, strongly sclerotized but colourless. Ninth abdominal tergite rounded distally.

Type in the British Museum (Nat. Hist.). The second male mentioned by Broun in the original description is not in the British Museum.

Geographic Variation.—Only two specimens are available in collections, so geographic variation has not been studied.

Distribution.—The writer has seen only two specimens of *auriculatus,* both from near the centre of the North Island. The type is from Thames; the other specimen known to the writer bears the label "Waikato" and it is not possible to know exactly where in the Waikato the specimen was found.

Biology.—Unknown.

SPECIMENS EXAMINED

NORTH ISLAND.—AUCKLAND: Type ♂, Thames, no other data (BMNH). 1 ♀, Waikato, no other data (BMNH).

Dorcus capito (Deyrolle) n.comb.

Figs 44–48, 108, 113, 119, 126

Lissotes capito Deyrolle in Parry, 1873, *Trans. ent. Soc. Lond.,* pt. 3: 339–340; pl. 5, figs 4, 5; male, female; original description. Type locality: Chatham Islands, about 460 miles east of New Zealand. Boileau, 1913, *Trans. ent. Soc. Lond.,* p. 262.

Lissotes Desmaresti Deyrolle, 1881, *Ann. Soc. ent. Fr.* (6) 1: 239–240; pl. 5, fig. 4; male, female; original description. Type locality: New Zealand. NEW SYNONYMY.

Lissotes dispar Broun, 1910, *Trans. N.Z. Inst.,* 42: 307–308; male; original description. Type locality: Te Whakaru, Chatham Islands. Brookes, 1925, *Rec. Canterbury (N.Z.) Mus.,* 2: 290–291. NEW SYNONYMY.

Females of *capito* differ from all other New Zealand species of *Dorcus* in having an elongate, approximately horizontal carina on the dorsal, medial edge of the mandible. Males are best distinguished from those of other New Zealand species by the postocular region of the head being dorsoventrally flattened immediately behind each eye, and by the form of the mandibles (described and figured below).

Body moderately small to very large and dull to glossy. Dorsal surface variably punctured (see below) with some of the punctures bearing short, erect, yellowish brown scales which tend to split longitudinally and may look like tufts of setae. Fresh specimens probably have squamose elytra. There are five to nine very fine, longitudinal striae on each elytron. Ventral surface more or less densely and moderately coarsely punctate; some of the punctures bear appressed, fine setae, or decumbent, short scales which are easily abraded.

Head (Figs 44–47) with the dorsal surface shallowly depressed immediately in front of each eye; preocular margin with a rim which is well developed in large specimens, weak in small specimens; canthus extending less than half the length of eye. Labrum with one median and two lateral protuberances on the distal edge. Galea without small hooks in some specimens, with as many as three small hooks in others; lacinia without small hooks. Mentum emarginate distally and with a few long setae. Second through seventh antennal segments slightly produced medially; antennal club 1·3 to 1·5 times wider than deep.

Pronotum with the front angles slightly obtuse and distant from the eyes; middle of anterior margin concave to convex; sides approximately parallel anteriorly, gradually converging posteriorly, and with an obscure, obtuse angle behind the middle; brim narrow. Scutellum very small, 1·3 to 1·8 times wider than long, and obtusely rounded apically; surface smooth or with scattered, fine punctures.

Elytral striae most distinct proximaliy; sutural margin not elevated. The elytral scales appear to be easily abraded, and in the females and large males examined by the writer they are present only near the lateral margins; in all the small males examined by the writer scales are uniformly distributed on the elytra.

Prosternal process flat or slightly convex between coxae, and with a small, densely punctate tubercle behind coxae. Mesosternum slightly convex between coxae. Thoracic sterna with setae and scales. First through fourth abdominal sternites with appressed, fine setae; fifth abdominal sternite mainly with decumbent scales.

Femora moderately coarsely punctured, and with fine scales and setae; fore and hind tibiae approximately equal in length, longer than middle tibia; inner edge of anterior tibia more or less uniformly concave; outer edge of anterior tibia with five to nine teeth which begin a short distance from the base; outer edge of middle and hind tibiae with one large spine, and in some specimens also with two or three small spines, near the middle; tibial spurs slender and conical except for the tips which are flattened; arolium with two bristles.

MALE

Length (with mandibles), 18·4 to 29·2 mm.; (without mandibles), 16·2 to 26·0 mm.: breadth, 7·5 to 13·5 mm.

The punctures on the dorsal surface are sparse and fine, those on the head and pronotum sparsest and finest, and the puncturation of large specimens is much finer than that of small specimens. Head widest behind the eyes; frontal depression

absent in large males, shallow and extending behind the level of the posterior margin of the eye in small males; frontal tubercle small in small males, absent in large males; postocular margin with an acute- or obtuse-angled projection which is slightly concave ventrally, horizontal dorsally, and is best developed in large males. Labrum 2·0 to 2·6 times wider than long, narrowest in small specimens; tubercles well developed; surface with a few fine punctures. Mandibles large, finely and moderately densely punctate, strongly allomorphotic. Specimens with length (minus mandibles) ranging from 16·2 to 21·2 mm. have slender, laterally arcuate mandibles (see Fig. 46) in which there is a strong, apical tooth directed inwards and slightly upwards, a bifurcated, ventral tooth near the middle of the mandible and directed medially, a short, conical tooth near the base of the bifurcated tooth, and a low, vertical carina on the medial, dorsal surface of the mandible towards the base; this carina is absent in the smallest specimens examined. When the mandibles are closed the apical tooth of the left mandible touches and is slightly anterior to that of the right mandible, and the tips of the bifurcated teeth meet. Specimens ranging in length from 23·0 to 26·0 mm. have stout mandibles (see Figs 44, 48) in which the proximal half is porrect and slightly arcuate laterally, and the distal half is directed upwards almost vertically. The angle between the proximal and distal parts of the mandible is smallest in large specimens. The apex of the mandible is bifurcate, and near the base there is a short, dorsal ridge and a small, ventral tooth. When the mandibles are closed the more anterior tooth at the apex on one side touches and is anterior to that of the other, either right or left mandible being more anterior. Lacinial point extending to or beyond the middle of the galea; fourth segment of maxillary palp 3·6 to 3·8 times longer than wide. Mentum 2·4 to 2·6 times wider than long; with coarse, dense punctures and numerous setae and scales in small males, with finer, sparser punctures and fewer setae and scales in large males; third segment of labial palp 3·1 to 3·8 times longer than wide, relatively longer and more slender in large males.

Pronotum 1·7 to 2·2 times wider than long, widest in large males, and 1·0 to 1·1 times the head width; sides not reflected. Elytra together 0·9 to 1·1 times the width of pronotum. Fifth abdominal sternite 3·2 to 3·7 times wider than long.

Male Genitalia (Fig. 108). Generally resembling those of *ithaginis* but differing in the following characters. The permanently everted internal sac is longer and broader, and the distal expansion is more elongate. The sclerite on the distal, ventral edge of the expansion is submarginal and very small. The gonopore is farther from the sclerite than it is in *ithaginis,* and a deep, narrow groove extends from the gonopore to the distal margin. Struts approximately 0·7 times the length of basal piece. Parameres about two-fifths the length of tegmen. Ninth abdominal segment as in Fig. 113.

FEMALE

Length (with mandibles), 19·0 to 26·5 mm.; (without mandibles), 18·0 to 24·5 mm.; breadth, 9·0 to 13·0 mm.

The punctures on the dorsal surface are coarse and dense. Head widest in

front, at, or behind the eyes; frontal depression shallow and irregular, extending behind the level of the posterior limit of the eyes; frontal tubercle large; postocular margin with a small, triangular projection immediately behind each eye (Fig. 45), this projection very small or absent in small specimens (Fig. 47). Labrum 2·5 to 3·4 times wider than long, widest in large specimens; tubercles small; surface coarsely and moderately densely punctate. Mandibles with coarse, dense punctures; each mandible with a strong, dorsal, apical tooth directed inwards, a bifurcated, ventral, subapical tooth directed inwards, and an elongate, horizontal lobe on the dorsal, medial edge. Fourth segment of maxillary palp approximately 2·7 times longer than wide. Mentum 2·1 to 2·2 times wider than long and with coarse, moderately dense punctures bearing setae and scales; third segment of labial palp 2·8 to 3·0 times longer than wide.

Pronotum 1·5 to 1·7 times wider than long and 1·3 to 1·5 times wider than head; sides slightly reflected. Elytra together 1·1 times the width of the pronotum. Fifth abdominal sternite 2·6 to 3·1 times wider than long.

Female Genitalia (Figs. 119, 126). This species differs from the other New Zealand species of *Dorcus* in having a very elongate accessory gland. Styli 1·0 to 1·3 times longer than wide, with the external and internal angles obtusely rounded and with the distal margin convex. Spermatheca very slender. Spermathecal duct short. Margin of ninth abdominal tergite convex or truncate distally.

Type material: location of type and allotype of *capito* unknown; type of *dispar* Broun in the British Museum (Nat. Hist.); location of type and allotype of *desmaresti* Deyrolle unknown.

Distribution and Geographic Variation.—This species occurs on the Chatham Islands, about 460 miles east of Christchurch. The most obvious geographic variation is in body size. All the large specimens (length excluding mandibles more than 22·0 mm.) examined by the writer are from Sisters Island, about 12 miles north-west of Chatham Island. Small specimens (length excluding mandibles less than 22·0 mm.) have been collected from the north-eastern and south-eastern extremities of Chatham Island, and from Mangere, Southeast and Pitt Islands, which lie close together about 15 miles south of the south-eastern corner of Chatham Island. Among the small males examined by the writer are two specimens from "Manuporu, Chatham Island", but it has not been possible to locate this place.

Striking differences in the shape of the mandibles of males, and minor differences in some other morphological structures occur between large and small specimens. The writer considers large and small specimens to constitute a single species for the following reasons:

(1) The genitalia are identical.

(2) Except for a slight difference, which is probably allometric, in the size of the postocular projection, females appear to be identical in gross morphology.

(3) The hindwings are similarly reduced in both large and small specimens.

(4) In the males examined there is no overlap in the body length (minus mandibles) associated with each of the two mandible forms; this seems to indicate that the mandibular differences result from allometry.

(5) The differences in puncturation of the dorsal surface, and in the development of the postocular projection, between large and small males are similar to those occurring in *D. helmsi.*

(6) On the basis of the material at present available, the two forms appear to be geographically isolated, but collecting has not been sufficiently intensive to show whether this isolation is apparent or real. If it should prove to be real, it would not be a unique example in the Lucanidae; *Lucanus cervus* Linn., a species in which mandibles of males are strongly allomorphotic, exhibits geographic variation in the distribution of various forms of males (Leuthner, 1885).

Biology.—No information is at present available about the biology of this species.

Synonymy.—The type of *capito* has not been examined by the writer, but the species is easily recognized from the figures accompanying the original description; the type specimen apparently is a small male. The writer has examined the type of *dispar* Broun; it is a small male of *capito.* The type material of *desmaresti* has not been available for study, but it is clear from the description and figure of the mandibles and head that the type is a large male of *capito;* the allotype of *desmaresti* is described as having a dorsal, horizontal lamina on the mandible, and this is characteristically present in females of *capito.* The type locality of *desmaresti* is given as "New Zealand", but presumably this is incorrect in the strict sense.

SPECIMENS EXAMINED

CHATHAM ISLANDS, approximately 460 miles east of New Zealand.—1 ♂ (type of *dispar*), Te Whakaru, Chatham I., no date, S. D. Shand (BMNH). 1 ♀, Chatham I., no date, Hutton Coll. (CM). 1 ♂, Chatham I., 1933, coll. ? (AM). 1 ♀, Chatham I., —.I.1938, N. G. Mitchell (EG). 10 ♂, 1 ♀, Sisters I., 29.I.1954, R. R. Forster (CM). 1 ♂, same locality and date, E. W. Dawson (CM). 2 ♂, 1 ♀. Mangere I., 4–21.I.1924, C. Lindsay (CM). 1 ♂, Owenga, Chatham I., —.II.1933, coll. ? (AM). 1 ♂, Southeast I., 3.II.1954, R. R. Forster (CM). 2 ♂, Manuporu, Chatham I., 2.I.1924, C. Lindsay (CM). 1 ♂, 1 ♀, Pitt I., 1928, coll. ? (AM).

LISSOTES WESTWOOD

Lissotes Westwood, 1855, *Trans. ent. Soc. Lond.,* new series, 3: 213. Type species: *Lissotes menalcas* Westwood, designated by Didier and Séguy, 1953, *Encyc. Ent.,* (A) 27: 172. Lea, 1911, *Papers and Proc. Roy Soc. Tasmania* (1910), pp. 364–47. Benesh, 1955, *Trans. ent. Soc. Amer.,* 81: 72–73.

Range.—Eastern and south-eastern Australia, New Zealand, Tasmania.

The essential characters of this genus are the hooked laciniae present in both males and females, and the incompletely divided eyes. Benesh (1955) has pointed out that, at the present time, *Lissotes* is composed of a number of very dissimilar species; those from New Zealand are quite distinct from the remaining species in being squamose and rather dull dorsally, and in showing little or no sexual dimorphism of the mandibles. In the few Australian species examined by the present writer the male genitalia, maxillae and labia also differ markedly from those of the New Zealand species. Although the New Zealand species appear to constitute a very uniform and distinct group it seems best to leave them in *Lissotes* at least until the Tasmanian and Australian species have been more thorougly examined.

Lissotes is represented in New Zealand at the present time by six species of small to moderately large-sized (total length less than 20·0 millimetres), blackish or reddish-brown beetles which are flattened dorsoventrally and are somewhat parallel-sided. Almost all of the cuticle is punctured, and most of the punctures bear appressed to erect short scales or setae which, in several species, are easily abraded. Sexual dimorphism is absent or slight.

The head is short and broad, with the anterior edge deeply and broadly emarginate and not rimmed. The eyes are small, slightly convex laterally and are partially divided by a short canthus. The preocular margin of the head is long and obtusely rounded. The postocular margin is short, straight or slightly convex, and is not lobate. The intermandibular projection is indistinguishable or very small. The labrum is short, broad, and has a tubercle near the centre of the external surface; there are long yellow hairs behind or on either side of the tubercle. The mandibles are asymmetrical, porrect, compact and robust, dull, densely punctate and devoid of vestiture. The teeth along the medial edge of the mandible are small and blunt; there are no vertical teeth. The maxilla of *reticulatus* (Fig. 14) is characteristic of the New Zealand species group; the galea is unarmed in *mangonuiensis* Brookes but has two to six hooks in the remaining New Zealand species; the lacinia has several very small hooklets below the large terminal hook which does not extend beyond the middle of the galea. The second segment of the maxillary palp is about 1·3 times longer than the third, and the terminal segment is not dilated. The labium of *reticulatus* (Fig. 18) is typical of all the New Zealand species; the external surface of the mentum is coarsely punctate and bears a few setae mainly near the margins. The terminal segment of the labial palp may be dilated or long and narrow, depending upon the species.

The antennae are moderately long; the scape is slender, slightly curved and about one-half the length of the entire antenna; second segment articulating on the dorsal surface of the scape as in *Dorcus* (Fig. 1) so that the antenna is distinctly geniculate. The antennal club is composed of three broad, stout segments which are setose on at least half of their external surface and are capable of being opposed. The second through seventh antennal segments are cylindrical and not tuberculate.

The pronotum is 1·2 to 1·5 times longer than wide and 1·3 to 1·6 times wider than the head. The front angles are acute and moderately prominent; the

remainder of the anterior margin is slightly convex and usually has a flattened, smooth rim near the sides. The hind angles are slightly obtuse and not prominent; the remainder of the posterior margin is slightly convex and narrowly rimmed. The sides are very obtusely angulate or rounded near the middle and are rimmed. Scutellum small but clearly visible between elytra, cordiform or triangular, 1·3 to 1·9 times wider than long, and with a few scales. The elytra together are about equal in width to the pronotum; elytral shoulders and sutural margin not prominent. Hindwings vestigial. Pro- and meso-sternal processes broad as in *Dorcus* (Fig. 7). Fifth abdominal sternite convex distally and similar in both sexes.

Legs stout and moderately short; fore and middle legs about equal in length and shorter than hind legs. As in *Dorcus* (Fig. 7) there is no procoxal process. Femora with moderately dense punctures which bear short setae and scales. Tibiae with about seven longitudinal, shallow grooves bearing setae and scales. Tarsi moderately long, each with a well developed arolium and a pair of bristles which project beyond the fifth tarsomere although the rod-like part of the arolium does not always extend beyond the tarsomere. Outer edges of middle and hind tibiae moderately convex; middle tibia with a large spine near the middle and with up to five small spines on the proximal half; hind tibia with a variably-sized spine near the middle (this is rarely absent). Fore tibia with a large, conical spur; middle and hind tibiae each with one large and one small, conical spur.

MALE GENITALIA

The most characteristic features of the male genitalia of the New Zealand species of *Lissotes* are the very large permanently everted internal sac, which is expanded distally into a massive, usually folded, saccate structure (not a flagellum), the three pairs of sclerites strengthening the permanently everted internal sac, the leaf-like parameres that are convex, not truncate, distally, and the short, broad penis which has a stout, strongly sclerotized support medially on the ventral side with a large, membranous cushion on either side of this support. It may be significant that the male genitalia of the Australian species of *Lissotes* (*L. darlingtoni* Benesh and *L. menalcas* Westwood examined) show more resemblance to those of the South American genus *Pycnosiphorus* Solier (*P. caelatus* examined) than to those of the New Zealand species of *Lissotes*: the permanently everted internal sac is more or less uniformly narrow throughout its length (not flagellate) and is strengthened by a single pair of sclerites (on either side of the ejaculatory duct), the leaf-like parameres are truncate distally, and the penis is elongate and narrow, with a slender, sclerotized support medially on the ventral side and with greatly reduced membranous cushions on either side of this support.

In the New Zealand species of *Lissotes* the shape of the median ventral sclerite of the penis and the size and shape of the cushions on either side of it are diagnostic for each species (see Figs. 127, 129–133). The permanently everted internal sac, when in repose, is held beneath the ninth abdominal sternite. The three pairs of sclerites strengthening the permanently everted sac are arranged as follows: the most proximal pair (Fig. 127, SC1) is slender and lies on either side of the

ejaculatory duct within the sac, becoming indistinct distally; the second pair (Fig. 127, SC2) lies on the ventral surface of the sac and the two sclerites may be long or short, depending upon the species; the third pair of sclerites (Fig. 127 SC3) lies on the dorsal surface of the distal part of the sac and its members are short and broad. In five of the six New Zealand species, there is a colourless, membranous papilla (Fig. 127, PL) on the ventral surface near the middle of the sac; this is absent in the sixth species. Figures 127 and 129–133 are arranged in a sequence to show the major changes that have occurred in the male genitalia of the New Zealand species of *Lissotes*. At one end of the series (*reticulatus*, Fig. 127), the genitalia have a large permanently everted internal sac with a well-developed papilla and two very large sclerites (SC2) on the ventral side of the sac near the papilla. As the genitalia decrease in size, accompanying the general reduction in body size of the various species, the permanently everted sac becomes progressively smaller, there is a gradual reduction in the size of the papilla, which has completely disappeared in the new species described in this paper (Fig. 133), and the ventral sclerites of the permanently everted internal sac become smaller and move away from the papilla.

In those species having a papilla on the internal sac, the outer surface of the part of the sac distal to the papilla bears dense, colourless or pale brown, small spines. Where the wall is thin, these spines (Fig. 128) are composed of a single large process which is external to the wall and has its tip directed towards the distal end of the sac, and several small spine-like processes which are embedded in the wall of the sac. Where the wall is thick, the writer has been unable to determine whether small internal processes are present on the spines, but the external processes are similar to those of spines in thin-walled areas. Some very long (about seven times the length of those in Fig. 128), straight, colourless spines lacking internal processes are present on the distal extremity of the permanently everted internal sac. In the one species (Fig. 133) lacking a papilla, the distal part of the internal sac is covered with rows of large, dark spines; it has not been possible to determine the structure of these.

Gonopore large and terminal. Basal orifice broad, basal. A pair of slender struts (Fig. 127, ST) articulating dorsolaterally on the base of the penis lies within the basal piece, which is membranous dorsally. The struts are about four-fifths the length of the basal piece.

The ninth abdominal segment is moderately strongly sclerotized and 1·1 to 1·4 times longer than the tegmen. The distal margin on the ventral surface is convex, that on the dorsal surface is truncate or emarginate.

FEMALE GENITALIA

The two genitalic characters separating females of the New Zealand species of *Lissotes* from those of all other New Zealand lucanids are the large, saccate bursa copulatrix, which has part of its ventral wall strongly sclerotized and pigmented, and the absence of a bursal duct. It has not been possible to examine the female genitalia of any of the Australian species of *Lissotes*. In the New

Zealand species, the hemisternites are moderately strongly sclerotized and pigmented, and each bears at its tip a small, setose stylus which is extremely variable intraspecifically. The spermatheca is small, bulbous, curved, feebly pigmented, not greatly sclerotized, and lacks annulations. The spermathecal gland is elongate or bulbous, and feebly sclerotized; its duct is short, with or without annulations, and enters the spermatheca near its base. The form of the bursa copulatrix is useful for separating the New Zealand species. The spermathecal duct is weakly sclerotized, narrow, moderately long, but variable in length. It opens into the bursa copulatrix between a pair of sclerites (on the inner surface of the bursa copulatrix). A large, soft, colourless sac, here regarded as an accessory gland, opens into the vagina at the level of entry of the median oviduct.

The following is a list of the New Zealand species of *Lissotes* recognized in the present study, together with a newly established synonym.

mangonuiensis Brookes
oconnori Holloway
planus (Broun)
reticulatus (Westwood)
rufipes Sharp
= *Lissotes elegans* Broun
stewarti (Broun)

The following species which have previously been referred to *Lissotes* (see Roon, 1910; Didier and Séguy, 1953; Benesh, 1960) have been transferred to *Dorcus* in the present study.

aemulus Broun = *D. helmsi* (Sharp)
auriculatus Broun = *D. auriculatus* (Broun)
capito Deyrolle = *D. capito* (Deyrolle)
desmaresti Deyrolle = *D. capito* (Deyrolle)
dispar Broun = *D. capito* (Deyrolle)
helmsi Sharp = *D. helmsi* (Sharp)
ithaginis Broun = *D. ithaginis* (Broun)
philpotti Broun = *D. philpotti* (Broun)

KEY TO THE NEW ZEALAND SPECIES OF *Lissotes* (MALES AND FEMALES)

(1) Dorsal surface of head very finely and very sparsely punctate except for three to six very distinct groups of coarse punctures (bearing scales in fresh specimens); elytral scales appressed; pronotum with a small, median tubercle near the anterior margin 5

Dorsal surface of head more or less uniformly coarsely and densely punctate; elytral scales decumbent to erect; pronotum not tuberculate — 2

(2) Proximal third of anterior tibia prominently constricted (see Fig. 56) — *planus* (Broun), p. 53

Proximal third of anterior tibia uniformly expanded, not constricted (see e.g. Figs 59 and 62) .... — 3

(3) Dorsal surface of head with a shallow frontal depression which extends back to the level of the posterior margin of the eye; anterior tibia slightly arcuate (Fig. 62) and not greatly expanded distally .... — *mangonuiensis* Brookes, p. 58

Dorsal surface of head not having a frontal depression that extends back as far as the level of the posterior margin of the eye, but there may be a depression extending back as far as the level of the anterior margin of the eye; anterior tibia not arcuate (see Fig. 59), and considerably expanded distally .... — 4

(4) Dorsal surface of proximal half of mandible coarsely and densely punctate; left mandible of male with four teeth (Fig. 57), of female with three teeth (Fig. 58) — *stewarti* (Broun), p. 56

Dorsal surface of proximal half of mandible finely and sparsely punctate (in male); left mandible of male (Fig. 64) with five teeth (female unknown) .... — *oconnori* n.sp., p. 60

(5) Dorsal surface of head with a small group of coarse punctures (bearing scales in fresh specimens) at the base of each mandible (Fig. 51); band of scales across posterior margin of pronotum irregular in width; band of scales across anterior margin of pronotum

broken medially by a narrow naked strip which is considerably less than one-third the pronotal width — *rufipes* Sharp, p. 51

Dorsal surface of head not coarsely punctate at the base of the mandibles (Fig. 49); band of scales across posterior margin of pronotum uniform in width; band of scales across anterior margin of pronotum broken medially by a broad naked strip which is at least one-third the pronotal width ..... — *reticulatus* (Westwood), p. 47

Lissotes reticulatus (Westwood)

Frontispiece, 10

Figs 14, 18, 49, 50, 127, 128, 134, 140, 145–153

Lucanus reticulatus Westwood, 1844, *Proc. ent. Soc. Lond.*, p. 106; sex not determined; original description. Type locality: New Zealand. Westwood, 1846, *Ann. Mag. nat. Hist.*, 17: 59. Westwood, 1847, *Trans. ent. Soc. Lond.*, 4: 275; pl. 20, fig. 4. White, 1846, *Voy. Erebus and Terror. Insects*, p. 9. Fairmaire, 1849, *Rev. Mag. Zool.*, (2) 1: 414 (synonyms; *reticulatus* misspelt *retriculatus*). Lacordaire, 1856, *Hist. nat. Insectes. Gen. Coléopt.*, 3: 31 (synonyms).

Dorcus squamidorsis White, 1846, *Voy. Erebus and Terror. Insects*, p. 9; pl. 2, fig. 2; sex not determined; original description. Type locality: Port Nicholson, New Zealand.

Lucanus zelandicus Blanchard, 1847, *Voy. Pôle Sud.* Atlas. *Insectes Coléopt.*, pl. 9, fig. 13; sex not determined. Type locality: New Zealand.

Aegus cicatricosus Burmeister, 1847, *Handb. Ent.*, 5: 403; sex not determined; original description. Type locality: New Zealand.

Aegus squamidorsis (White) Blanchard, 1853, *Voy. Pôle Sud. Zoologie*, 4: 140–41 (synonyms).

Lissotes reticulatus (Westwood), Westwood, 1855, *Trans. ent. Soc. Lond.*, new series, 3: 218; pl. 12, figs 9a, 9b (synonyms).

Sclerostomus cicatricosus (Burmeister) Thomson, 1862, *Ann. Soc. ent. Fr.*, (4) 2: 400 (synonyms).

Dorcus reticulatus (Westwood) Parry, 1863, *Trans. ent. Soc. Lond.*, (3) 1: 450–51 (synonyms).

This species is best distinguished by the arrangement of the scales (dull yellowish-brown, appressed, and arising from coarse punctures) on the head and pronotum. There are four groups of scales on the head; two of these are along

the medial edge of the eye; the other two are close together in the centre of the frons. On the pronotum there are four symmetrical, discal groups of scales, and there is a uniformly wide band of scales along the posterior and lateral margins and on not more than two-thirds of the anterior margin. The elytra are reticulated with several narrow, elevated bands which are not squamose.

Body large, very dark brown (rarely reddish) and dull to moderately glossy. The non-squamose areas on the dorsal surface are finely and sparsely punctate. Ventral surface moderately densely punctured; punctures on prosternal process, middle third of metasternum, and middle of first through fourth abdominal sternites small and without vestiture; remainder moderately coarse and with short, narrow, appressed, brown scales or setae.

Head (Fig. 49) with the frontal depression extending back to the level of the posterior margin of the eye; dorsal surface hollowed out immediately in front of the eye, with the preocular margin elevated. Labrum truncate, and 1·5 to 1·9 times wider than long. Mandibles moderately coarsely punctate; each mandible with a strong, apical tooth, a small, subapical, ventral tooth, a small, subapical, dorsal tooth (all directed medially), and with a broad bifurcated lobe, directed anteroventrally, near the base on the medial, ventral edge. There is a small, vertical lobe behind the dorsal, subapical tooth. Maxilla as in Fig. 14; galea with two or three small hooks. Labium as in Fig. 18.

Pronotum with a small, median tubercle near the anterior margin; remainder of midline with a very fine groove; sides very obtusely angulate behind the middle, and with a narrow brim. The four groups of scales on the disc are in deep, approximately circular depressions on either side of the midline; the distance between the two anterior depressions is 0·29 to 0·37 times the width of the pronotum.

Elytra as in Fig. 50; scales appressed; elytral margin slightly reflected.

Prosternal process flattened between coxae, convex but not tuberculate behind coxae. Fifth abdominal sternite 3·1 to 3·5 times wider than long.

Femora with very fine punctures; tibiae with setae and narrow scales; anterior tibia more or less uniformly expanded from base to the distal end, the inner edge slightly concave, outer edge with six to 10 teeth.

MALE

Length (with mandibles), 12·7 to 19·2 mm.; (without mandibles), 11·6 to 17·5 mm.: breadth, 5·3 to 8·1 mm.

Terminal segment of maxillary palp about 2·8 times longer than wide. First segment of labial palp about 2·4 times longer than second; third segment about 2·4 times longer than wide.

Male Genitalia (Figs 127, 128). Permanently everted sac very large, considerably folded distally; ventral sclerites (SC2) very large; papilla very large. Ninth abdominal segment as in Fig. 134.

FEMALE

Length (with mandibles), 13·8 to 19·4 mm.; (without mandibles), 12·8 to 18·0 mm.: breadth, 5·8 to 8·5 mm.

Terminal segment of maxillary palp about 3·4 times longer than wide. First segment of labial palp about 2·8 times longer than second; third segment about 2·7 times longer than wide.

Female Genitalia (Figs 140, 145–153). Styli very variable, 0·3 to 1·0 times longer than wide; internal angle obtusely rounded to sharply acute; external angle sharply acute. Ventral surface of bursa copulatrix with many sclerotized, pigmented folds on the distal half, and with a pair of narrow sclerites projecting into the lumen. Distal margin of ninth abdominal tergite notched, truncate or rounded.

Types: Location of type of *reticulatus* unknown; type of *squamidorsis* White in the British Museum (Nat. Hist.); location of types of *zelandicus* Blanchard and *cicatricosus* Burmeister unknown.

Variation.—This species exhibits a large amount of individual variation in body size, extent of squamose areas on the elytra, and in the size of the mandibular teeth. Although the elytral scales may be abraded, their original location is easily determined from the coarsely punctate areas on the cuticle. Variation in the size of the mandibular teeth does not always result from genetic differences; in some specimens the teeth have been worn down with use. Worn teeth may be recognized by their very truncate tips, and by the worn surface being light brown in colour in contrast to the dark brown coloration of the rest of the mandible. The writer has not detected any geographic variation in mandibular teeth size or in the extent of squamosity of the elytra. Body size, while exhibiting a great deal of local variation, seems to vary geographically in that specimens from the South Island, especially from north and west of Christchurch, tend to be considerally smaller than those from the North Island.

Almost all of the structures of the female genitalia are highly variable locally. Some of the forms of styli are shown in Figs 145–153; in the material examined, there is a tendency for the internal angle of the stylus to be rounded rather than angular in specimens from Canterbury. The spermathecal duct tends to be short in South Island specimens, longer in North Island specimens, in the material studied.

Distribution.—This is a widely distributed species; its present known range extends from Te Aroha Mt. in the North Island to Christchurch in the South Island. The writer has seen no specimens from west of the Southern Alps, and since many parts of that area have been thoroughly collected entomologically there is reason to suppose that this species does not occur there. As no specimens of *reticulatus* have been collected from the vicinity of Auckland city the range probably does not extend that far north. Similarly, it is doubtful whether *reticulatus* occurs very far south of Christchurch.

Biology.—Adults and larvae of this species are commonly found in decaying wood that is in contact with the ground, and adults occasionally occur under bark of living trees, especially beech (*Nothofagus*). Hudson (1934) has described and figured the larva and has also figured the pupa, which is enclosed in a cocoon composed of soil or decayed wood. Adults occur throughout the year. Pupae have been collected in January. In adult males and females the mandibular teeth and the teeth of the anterior tibiae are often greatly worn down, and in such specimens the dorsal surface of the pronotum and of the posterior part of the head is dull and scratched, indicating that these are burrowing beetles.

Synonymy.—In general appearance, *reticulatus* is very similar to *rufipes* Sharp, which was described in 1886, and on the basis of Westwood's original description the two species cannot be separated. However, *reticulatus* is readily identified from the redescription given by Westwood in 1847. The types of *zelandicus* Blanchard and of *cicatricosus* Burmeister are unknown to the writer but it is clear from the original descriptions that they are specimens of *reticulatus*. The type of *squamidorsis* White has been examined by the writer and falls well within the range of variation of *reticulatus*.

SPECIMENS EXAMINED

NORTH ISLAND.—AUCKLAND: 1 ♂, Te Aroha Mt., 14.IV.1954, N. P. Hallett (AM). 1 spec., Motu, —.V.1928, A. E. Brookes (PDD). 1 ♀, Rotomahana, 9.XII.1958, B. Carruthers (DM). TARANAKI: 1 ♂, 1 ♀, Mt. Egmont, —.I.1933, E. A. Plank (DM). WELLINGTON: 1 ♀, Ohakune, —.X.1923, M. Harris (AM). 2 ♂, 2 ♀, Ohakune, 18–23.I.1927, A. Castle (DM). 1 ♂, Taihape, 25.I.1927, A. Castle (PDD). 1 ♀, Mt. Holdsworth, 30.XI.1930, E. A. Plank (DM). 1 ♂, 1 ♀, Whakatiki River (5 miles from Paekakariki), 21.X.1923, T. Cockcroft (AM). 3 ♂, 1 ♀, Akatarawa, 6.II.1953, M. Redington (DM). 1 ♀, Akatarawa, 19.XII.1952, M. Redington (DM). 1 ♀, Little Akatarawa, 26.X.1941, M. Laird (DM). 1 ♀, Heretaunga, —.X.1918, A. C. O'Connor (DM). 1 ♂, Silverstream, 6.VI.1954, G. W. Ramsay (DM). 1 ♂, 1 ♀, Stokes Valley, 15.XI.1952, D. V. and B. A. Holloway (DM). 1 ♀, Belmont, 9.IV.1953, P. C. Bull (DM). 2 ♀, Korokoro, 13.X.1933, T. Cockcroft (AM). 1 ♀, Petone, 20.IX.1941, R. R. Forster (DM). 1 ♂, Days Bay, 22.I.1930, E. A. Plank (DM). 1 ♂, Day Bay, 2.VIII.1953, R. A. Falla (DM). 1 ♂, 1 ♀, Days Bay, 20.X.1941, R. R. Forster (DM). 1 ♂, 1 ♀, Days Bay, 23.X.1941, R. R. Forster (PDD). 1 ♀, Days Bay, 18.XI.1941, R. R. Forster (DM). 1 ♂, Days Bay, 6.V.1934, E. A. Plank (DM). 1 ♀, Butterfly Creek, 13.VI.1932, E. A. Plank (DM). 1 ♀, Gollans Valley, 11.XI.1923, A. C. O'Connor (DM). 1 ♂, 1 ♀, in cop., Gollans Valley, 11.IX.1923, A. Castle (DM). 1 ♀, Kapiti I., 24.VIII.1947, R. R. Forster (DM). 2 ♀, Titahi Bay, 14.I.1919, A. C. O'Connor (DM). 1 ♂, Khandallah, 6.VI.1935, J. T. Salmon (DM). 1 ♂, Happy Valley, 3.III.1941, R. R. Forster (PDD). 1 ♀, Happy Valley, 23.VIII.1941, R. R. Forster (DM). 1 ♂, Wellington, no date, G. V. Hudson (DM). 1 ♂, 1 ♀, Wellington, no date, Buller Coll. (DM). 1 ♂, Wellington, 20.XI.1931, B. C. Aston (DM).

SOUTH ISLAND.—NELSON: 2 ♂, Stephens I., 20.XII.1954, G. W. Ramsay (DM). 1 ♂, Mt. Maungatapu, 19.I.1947, G. W. Ramsay (DM). 1 ♂, 2 ♀, Takaka

Hill (2,000 ft), 14.XII.1953, E. S. Gourlay (EG). 1 ♂, Aniseed Valley, 9.XII.1953, E. S. Gourlay (EG). 2 ♂, Nelson, 10.III.1934, E. S. Gourlay (EG). 1 ♀, Dun Mt. (2,500 ft), 9.II.1952, E. S. Gourlay (EG). 1 ♀, Dun Mt. (2,000 ft), 14.I.1946, E. S. Gourlay (EG). CANTERBURY: 5 ♂, 1 ♀, East Grey River, 21–24.I.1921, coll. ? (CM). 1 ♂, 1 ♀, Mt. Grey, 24.II.1924, coll. ? (CM). 1 ♂, Mt. Grey, 10.XII.1916, S. Lindsay (AM). 1 ♂, Mt. Grey, 30.XII.1916, coll. ? (CM). 1 ♀, Mt. Grey, —.XI.1917, coll. ? (CM). 4 ♂, 4 ♀, Cass, 27.XII.1942, coll. ? (AM). 4 ♂, 2 ♀, Otarama, 17.X.1921, G. Archey (CM). 1 ♀, Mt. Algidus, 10.II.1946, R. R. Forster (DM). 5 ♂, 2 ♀, Kowhai Bush, 19.VI.1938, coll. ? (CM). 1 ♂, Akaroa, 4.IV.1923, coll. ? (CM). 1 ♀, Akaroa, 24.IV.1923, coll. ? (CM). 2 ♂, Hoon Hay, 15.I.1922, coll. ? (CM). 1 ♂, Kennedy's Bush, 3.III.1924, coll. ? (CM). 1 ♀, Deans Bush, 18.III.1925, A. Tonnoir (CM). 1 ♂, Deans Bush, 19.XII.1949, Haldane and Dugdale (CM). 1 ♂, Prices Bush, 24.X.1934, S. Lindsay (CM). 1 ♀, Riccarton Bush, 9.VI.1922, E. S. Gourlay (EG). 1 ♀, Riccarton Bush, 7.X.1928, E. S. Gourlay (EG). 1 ♂, Port Hills, 23.XII.1942, coll. ? (AM). 1 ♀, Puke Atua Bush, 6.X.1928, E. S. Gourlay (EG).

Lissotes rufipes Sharp

Frontispiece, 11
Figs 51, 52, 129, 135, 141, 154–156

Lissotes rufipes Sharp, 1886, *Trans. Roy. Dublin Soc.*, (2) 3: 398; sex not determined; original description. Type locality: Picton, New Zealand.

Lissotes elegans Broun, 1893, *Man. N.Z. Coleopt.*, pt. 5: 1110; sex not determined; original description. Type locality: Mt. Arthur, New Zealand. NEW SYNONYMY.

This species is very similar in appearance to *reticulatus*. It may be distinguished from *reticulatus* by its more glossy cuticle, by two additional squamose areas on the head (at the base of the mandibles), by the scales on the anterior margin of the pronotum being continuous except for a median naked strip which is considerably less than one-third the pronotal width, and by the non-squamose areas on the elytra being rather broad. Other differences are as follows:

Body more slender. Non-squamose areas on the dorsal surface more finely and sparsely punctulate and, in general, having a greenish-blue tinge when viewed under a dissecting microscope. Scales on dorsal surface denser, shorter, broader, and a more intense yellow; groups of scales more clearly demarcated from remainder of cuticle than in *reticulatus*. Sides of abdominal sternites with elongate, narrow, deep yellow scales arising from coarse punctures. Punctures on remainder of ventral surface finer and sparser than in *reticulatus*.

Frontal depression more triangular in shape; front of head more deeply emarginate than in *reticulatus* and with a large group of scales at the base of each mandible (see Fig. 51); preocular margin more angular above scape base and with the dorsal surface more shallowly hollowed out in front of eye; the

two groups of scales on frons larger and more clearly demarcated than in *reticulatus*. In the female, the right mandible lacks a ventral tooth and the left mandible has the basal lobe on the medial edge undivided. Maxilla with as many as six small hooks on the galea.

Pronotum more convex dorsally; front angles less sharply acute; median groove absent; sides more sharply angulate. Band of scales across anterior margin broken medially by a narrow naked strip which is considerably less than one-third the pronotal width. Band of scales across posterior margin very irregular, deepest in the middle, and narrow or absent behind the posterior pair of discal depressions. Distance between anterior pair of discal depressions 0·22 to 0·29 times the width of pronotum.

Elytra as in Fig. 52; non-squamose areas smoother and more extensive than in *reticulatus*.

Scales on thoracic sterna broader, shorter, and darker than in *reticulatus*. Scales on sides of first through fourth abdominal sterna rather sparse; those on the sides of fifth sternite denser and forming a conspicuous, broad band.

Tibiae with broad scales among the setae.

MALE

Length (with mandibles), 14·2 to 17·4 mm.; (without mandibles), 13·0 to 15·7 mm.: breadth, 5·6 to 6·7 mm.

Male Genitalia (Fig. 129). Similar to those in *reticulatus* except for the following: permanently everted internal sac shorter; papilla smaller; ventral pair of sclerites on sac more slender. There are slight differences in the shape of the sclerites and cushions of the penis (compare Figs 127 and 129). Ninth abdominal segment as in Fig. 135.

FEMALE

Length (with mandibles), 15·0 to 18·6 mm.; (without mandibles), 13·8 to 16·9 mm.: breadth, 5·8 to 7·3 mm.

Female Genitalia (Figs 141, 154–156). Differing from those of *reticulatus* in the following characters: styli 0·7 to 1·1 times longer than wide; bursa copulatrix less strongly sclerotized and pigmented, and with the two sclerites joined for most of their length; spermathecal duct shorter; distal margin of ninth abdominal tergite truncate, rounded or sharply acute.

Types of *rufipes* and *elegans* Broun in the British Museum (Nat. Hist.). The sex of these has not been determined. The type of *rufipes* is a small specimen with the following measurements: length (with mandibles), 13·4 mm.; (without mandibles), 12·5 mm.: breadth, 5·4 mm.

Variation.—There is a large amount of individual variation in body size, size of mandibular teeth, and in the extent of squamose areas on the elytra. The styli of this restricted species vary a great deal in shape and size (see Figs 154–156)

but variation in the remainder of the female genitalia is slight. No trends in geographic variation have been detected in the small sample available for examination.

Distribution.—This species occurs in the extreme north of the South Island, especially in the mountainous region of Nelson, where it is sympatric with *reticulatus*. Although two specimens among the material examined are stated to be from the North Island (Wellington) it is rather doubtful whether the locality records on these are correct. Probably *rufipes* does not occur outside the Nelson and Marlborough Provinces of the South Island.

Biology.—As in *reticulatus* the adult stage is not confined to a single season. The larvae are unknown to the writer. Adults are found in or under decaying logs which are in contact with the ground. In the specimens examined, the mandibular teeth and tibial teeth are not worn.

Synonymy.—The writer has examined the type of *elegans* Broun and considers it to fall well within the range of variation shown by *rufipes*.

SPECIMENS EXAMINED

NORTH ISLAND (doubtful records).—1 ♂, Wellington, 1923, G. V. Hudson (AM). 1 ♀, Wellington, no date, G. V. Hudson (DM).

SOUTH ISLAND.—NELSON: 1 ♂, Mt. Maungatapu (2,000 ft), 19.I.1947, G. W. Ramsay (DM). 2 ♂, Mt. Arthur (3,000 ft), 6.III.1935, E. S. Gourlay (EG). 5 ♂, 1 ♀, Flora Camp (about 3,000 ft), Mt. Arthur, 12.I.1918, A. C. O'Connor (DM). 2 ♀, Mt. Arthur, 14.I.1920, G. V. Hudson (DM). 1 spec. (type of *elegans*), Mt. Arthur, no other data (BMNH). 1 ♂, 1 ♀, Upper Maitai, 6.I.1933, E. S. Gourlay (EG). 1 ♂, Upper Maitai, 20.XI.1938, E. S. Gourlay (EG). 1 ♀, Upper Maitai, 20.XI.1927, E. S. Gourlay (EG). 1 ♀, South Branch of Maitai, 17.V.1952, B. A. Holloway (DM). 1 ♀, Dun Mt. (2,000 ft), 15.V.1952, B. A. Holloway (DM). 1 spec., Base of Mt. Owen, 12.III.1938, C. E. Clarke (BMNH). 1 ♀, Fringe Hill (2,000 ft), no date, A. C. O'Connor (DM). 1 ♀, Takaka, 4.II.1938, A. Richardson (AM). 1 ♂, Nelson, 10.VIII.1943, B. B. Given (EG). 1 ♀, Nelson, 12.II.1934, E. S. Gourlay (AM). MARLBOROUGH: 2 ♂, 1 ♀, Pelorus Sound, 6.XII.1920, A. C. O'Connor (DM). 1 spec., Mt. Stokes Ridge (2,500 ft), —.X.1944, A. C. O'Connor (PDD). 1 spec. (Holotype), Picton, no date, Helms (BMNH).

Lissotes planus (Broun)

Frontispiece, 14

Figs 53–56, 130, 136, 142, 157

Dorcus planus Broun, 1880, *Man. N.Z. Coleopt.*, pt. 1: 252; male; original description. Type locality: Parua, Whangarei, New Zealand.

Lissotes planus (Broun), Roon, 1910, *Coleopt. Catal.*, pt. 8: 48.

The most distinctive character of *planus* is the prominent constriction on the basal third of the anterior tibia. The scales of the dorsal surface, unlike those of the preceding two species, are erect to decumbent, not appressed, and are easily abraded. These scales arise from coarse punctures, but as both squamose and non-squamose areas of the cuticle are similarly coarsely punctate, the arrangement of scales on the elytra and pronota of abraded specimens is not discernible.

Body moderately large, rather dull, and dark brown or reddish-black. Dorsal surface coarsely and densely punctate, most of the punctures with dark yellowish-brown, moderately long and narrow, erect to decumbent scales. Prosternal process, sides of prosternum, and of first through fourth abdominal sternites with sparse, small punctures bearing appressed setae or scales. Remainder of ventral surface coarsely and densely punctate, with appressed or suberect scales and setae.

Head (Figs. 53 and 54) with the frontal depression extending beyond the level of the posterior limit of eye. In large specimens, a low, transverse ridge usually extends across the depression near the level of the anterior margin of the eyes. Dorsal surface of head slightly depressed immediately in front of each eye; preocular margin elevated slightly. In fresh specimens there are two small groups or one large group of scales in the middle of the frons and a large cluster of scales along the medial edge of each eye. There are a few scales on the anterior margin of the head, near the mandibles. All the groups of scales are more irregular in outline than are those in *reticulatus* and *rufipes*. Labrum truncate and about 1·5 times wider than long. Mandibles coarsely punctate near the base, finely punctate apically. Maxilla with five small hooks on galea.

Pronotum with a shallow groove on the midline; sides very obtusely angulate behind the middle and slightly brimmed. A wide, irregular band of scales extends all the way around the pronotum except for the middle third of the anterior margin. Disc with four very shallow, indistinct depressions bearing scales which are more nearly appressed than those elsewhere on the dorsal surface; distance between anterior pair of depressions 0·28 to 0·38 times the pronotal width.

Elytra as in Fig. 55; scales decumbent and appressed; non-squamose areas small, glossy, slightly elevated; elytral margins reflected slightly.

Prosternal process slightly concave to slightly convex between coxae, flattened or slightly convex behind coxae. Fifth abdominal sternite 2·7 to 3·2 times wider than long.

Femora moderately coarsely punctate; tibiae with setae and narrow scales; anterior tibia (Fig. 56) prominently constricted basally, and with four to nine teeth on the outer edge.

MALE

Length (with mandibles), 14·6 to 19·7 mm.; (without mandibles), 13·6 to to 17·7 mm.: breadth, 6·0 to 8·2 mm.

Mandibles (Fig. 53) slender, and strongly curved laterally; with a dorsal and a ventral tooth apically (dorsal tooth usually with a large medial expansion near its base), and with a rounded or bilobed prominence medially near the base; right

mandible with a small, subapical, dorsal tooth. Terminal segment of maxillary palp about 2·5 times wider than long. First segment of labial palp about 2·8 times longer than second; third segment about 2·6 times longer than wide.

Male Genitalia (Fig. 130). Resembling those of *reticulatus* except that the permanently everted sac is smaller, the papilla is greatly reduced in size, and the ventral pair of sclerites is distant from the papilla. There are also differences in the shape of the sclerites and of the membranous cushions of the penis (compare Figs. 127 and 130). Ninth abdominal segment as in Fig. 136.

FEMALE

Length (with mandibles), 13·0 to 17·3 mm.; (without mandibles), 12·2 to 16·1 mm.: breadth, 5·8 to 7·2 mm.

Mandibles stout, short, and not greatly curved (Fig. 54); left mandible with a strong apical tooth, and with two small teeth on the medial edge; right mandible with a strong, apical tooth, a small, subapical, dorsal tooth, and a bilobed prominence near the middle of the medial edge. Maxillary palp shorter than in male; terminal segment about 2·4 times longer than wide. Labial palp shorter than in male; first segment about 3·5 times longer than second; third segment about 1·8 times longer than wide.

Female Genitalia (Figs 142, 157). Differing from those of *reticulatus* mainly in the following characters: styli 0·7 to 1·5 times longer than wide and with the internal angle always sharply acute (in material examined); bursa copulatrix less strongly sclerotized and pigmented, with the pair of sclerites broad, plate-like, and feebly sclerotized; spermathecal duct longer.

Type in the British Museum (Nat. Hist.). Broun described *planus* from four males. Of these, only one specimen, labelled type, is in his collection at the British Museum. There is a male, labelled cotype, in the general lucanid collection at the British Museum.

Variation.—There is local variation in body size, mandibular teeth size, and in the extent of squamose areas on the dorsal surface. No geographic trends have been detected by the writer in the small sample available for study.

Distribution.—The present known, and probably actual, range of this species is the northern half of the North Island.

Biology.—Adults of this species have been collected throughout the year. Several specimens, both males and females, among the material examined have the apical teeth of the mandibles worn down considerably. This, together with the fact that the scales of the dorsal surface are often abraded, suggests that the adults are tunnellers.

SPECIMENS EXAMINED

NORTH ISLAND.—AUCKLAND: 2 ♂, Waipoua Forest, 1930, A. C. Forbes (DM). 1 ♂, Waimatenui, —.II.1939, coll. ? (AM). 1 ♂, 1 ♀, Waimatenui, 23.IV.1943, coll. ? (AM). 2 ♂, 1 ♀, Waimatenui, 1.IV.1945, C. E. Clarke (AM). 1♀, Waipu, 1913, T. Broun Dup. Coll. (PDD). 1 ♂, Kara, 24.XII.1926, E.

Fairburn (EG). 1 ♂, Kara Forest, 15.X.1927, E. Fairburn (PDD). 1 ♂ Tauraroa, 9.III.1929, E. Fairburn (DM). 1 ♀, Tauraroa, 22.XII.1928, E. Fairburn (EG). 1 ♂ (Holotype), Parua, Whangarei Heads, no other data (BMNH). 1 ♀, Hauto Mt., 30.I.1928, E. Fairburn (DM). 1 ♀, Waitakere Ra., 18.V.1941, D. Spiller (PDD). 2 ♂, 2 ♀, Waitakere Track, 1.I.1944, M. W. Carter (PDD). 1 ♀, Titirangi, 4.I.1937, A. J. Hipwell (EG). 1 ♂, Titirangi, 1934, A. Richardson (AM). 1 ♀, Titirangi, 8.II.1953, C. R. Thomas (PDD). 1 ♀, Fairy Falls, 2.I.1949, J. Edwards (PDD). 1 ♂, Orere Point, 26.IV.1940, D. Spiller (PDD). 1 ♂, Okauia, 22.I.1927, coll. ? (AM).

Lissotes stewarti (Broun)

Frontispiece, 12, 13
Figs 57–59, 131, 139, 143, 158, 159

Dorcus stewarti Broun, 1881, *Man. N.Z. Coleopt.*, pt. 2: 673; male; original description. Type locality: Wellington, New Zealand.
Lissotes stewarti (Broun), Roon, 1910, *Coleopt. Catal.*, pt. 8: 49.

In size, colour, and general external appearance *stewarti* is very similar to both *mangonuiensis* and *oconnori,* although differences between the male genitalia of the three species are very striking. The mandibles seem to offer the best external morphological characters for separating these species, and the extent of the frontal depression also is useful as a diagnostic character. (The female of *oconnori* is unknown.) Mandible shape in the three species is illustrated in Figs 57, 58, 60, 61, and 63, and is discussed in the text. In *stewarti* there is no distinct frontal depression and the dorsal surface of the preocular region of the head is almost vertical, whereas in the other two species there is a distinct frontal depression and the dorsal surface of the preocular region is more horizontal than vertical.

Body small, dull to glossy; dorsal surface dark brownish- or reddish-black; ventral surface and legs more reddish; dorsal and ventral surfaces almost uniformly covered with coarse, dense, circular punctures, those of the ventral surface bearing short, appressed or decumbent scales or appressed setae, those of the dorsal surface probably bearing standing scales (in the specimens examined by the writer the dorsal surface is considerably worn, and short, erect and suberect scales occur only near the posterior and lateral margins).

Head (Figs 57, 58) slightly convex to slightly concave between the eyes and without a frontal depression; dorsal surface not hollowed out immediately in front of eye; preocular margin not elevated. The punctures on the dorsal surface of the head are less dense near the anterior and posterior margins. Labrum truncate or rounded, and 1·4 to 1·6 times wider than long. Mandibles not very arcuate; punctures large near the base, small near the apex. Maxilla with as many as six small hooks on the galea. First segment of labial palp about three times longer than second; third segment about two times longer than wide.

Pronotum with or without a shallow median groove; sides very obtusely angulate near the middle, and without a brim.

Elytral margins not reflected. In most of the specimens examined each elytron has three or four indistinct, longitudinal, low ridges.

Prosternal process flattened or slightly concave between and behind coxae. First through fourth abdominal sternites less densely punctate laterally than near the middle; fifth abdominal sternite uniformly densely punctate, and 3·3 to 3·7 times wider than long.

Femora very coarsely punctate; tibiae setose; middle and hind tibiae also with scales; anterior tibia (Fig. 59) with three to five teeth on the outer edge.

MALE

Length (with mandibles), 10·8 to 14·0 mm.; (without mandibles), 9·8 to 12·3 mm.: breadth, 4·5 to 5·4 mm.

Mandibles (Fig. 57) each with a large, apical tooth and a small, subapical, ventral tooth; right mandible with a small, subapical, dorsal tooth and with a bilobed, basal tooth on the medial edge; left mandible with two lobes on the medial edge. Terminal segment of maxillary palp about 3·0 times longer than wide.

Male Genitalia (Fig. 131). Resembling those of *reticulatus* except that the papilla is smaller, and the ventral pair of sclerites is short, broad, and distant from the papilla. There also are differences in the shape of the sclerites and of the membranous cushions of the penis. In the male collected from Turanganui River (Wairarapa) the membranous lobes of the penis are more extensive proximally and laterally than they are in the specimen figured and than they are in any other specimens examined. Ninth abdominal segment as in Fig. 139.

FEMALE

Length (with mandibles), 11·8 to 13·6 mm.; (without mandibles), 10·6 to 12·4 mm.: breadth, 4·7 to 5·8 mm.

Mandibles as in Fig. 58; right mandible with an apical tooth, a small, subapical, dorsal tooth, and a bilobed, basal tooth on the medial edge; left mandible with an apical tooth, and with two large teeth on the medial edge. Terminal segment of maxillary palp about 2·5 times longer than wide.

Female Genitalia (Figs 143, 158, 159). Differing from those of *reticulatus* mainly in the following characters: styli 0·7 to 1·3 times longer than wide and with the external angle acute, internal angle approximately right-angled; dorsal surface of bursa copulatrix with a broad, sclerotized band which has several longitudinal folds and is split in the region where the spermathecal duct enters the bursa copulatrix.

Type in the British Museum (Nat. Hist.). Broun described this species from three specimens, one from Wellington, the other two from Auckland. The specimen from Wellington bears the type label.

Variation.—There is local variation in body size, in the size and distribution of the teeth along the medial edge of the mandible, and in the shape of the pre-

ocular margin of the head (very convex in some specimens, angulate in others). No trends in geographic variation have been detected in the small sample available for study.

Distribution.—Most of the specimens examined are from North Auckland, but specimens have also been collected from the Wellington Province so the species probably is generally distributed throughout the North Island. One of the specimens examined is stated to be from Christchurch but it is very likely that this specimen was collected in Auckland.

Biology.—No information is available about the biology of *stewarti*. In some specimens the mandibular teeth are worn and the scales on the dorsal surface are abraded so the adults probably are wood tunnellers.

SPECIMENS EXAMINED

NORTH ISLAND.—AUCKLAND: 1 ♂, Herekino, —.I.1930, coll. ? (AM). 1 ♀, Kara, 18–20.III.1931, E. Gourlay (EG). 1 ♂, same data (CM). 1 ♂, 2 ♀, Kara Forest, 15.X.1927, E. Fairburn (PDD). 1 ♂, Kara Forest, 3.XII.1927, E. Fairburn (PDD). 1 ♂, 1 ♀, Whangarei, 7.I.1927, coll. ? (AM). 1 ♂, Whangarei, no date, Lewis Coll. (DM). 2 ♀, Titirangi, 18.IX.1915, A. E. Brookes (PDD). 1 ♂, Waitakere Ra., 5.IX.1922, coll. ? (BMNH). 1 ♂, Karekare, 15.II.1916, A. E. Brookes Coll. (PDD). 1 ♂, Waiheke I., 20.V.1941, G. Chamberlain (PDD). 1 ♂, Waiheke I., 12.XII.1949, G. Chamberlain (DM). 1 ♂, Northcote, no other data (BMNH). 1 ♂, Auckland, —.II.1945, G. Chamberlain (Hudson Coll., DM). 1 ♂, Ligars Bush, Papakura, no other data (BMNH). 1 ♀, Ligars Bush, no date, A. E. Brookes Coll. (PDD). WELLINGTON: 1 ♂, Rangitikei River, 9.IV.1938, coll. ? (AM). 1 ♂, Turanganui River, Wairarapa, —.IX.1948, A. C. O'Connor (PDD). 1 ♂ (Holotype), Wellington, no other data (BMNH). SOUTH ISLAND (doubtful record).—CANTERBURY: 1 ♀, Hagley Park, Christchurch, —.XII.1935, G. Chamberlain (PDD).

Lissotes mangonuiensis Brookes

Figs 60–62, 132, 137, 144

Lissotes mangonuiensis Brookes, 1927, *Trans. Proc. N.Z. Inst.*, 57: 564–65; fig. 1; male, female; original description. Type locality: Oruru, Mangonui (North Auckland), New Zealand.

This small beetle is very similar in external appearance to both *stewarti* and *oconnori*. It is most readily distinguished from these by the shape of the mandibles and of the frontal depression (see Figs 60, 61), and by the form of the genitalia.

Body small, glossy, dark brownish-black; dorsal and ventral surfaces almost uniformly covered with moderately fine, dense, circular punctures (finer than those in *stewarti* and *oconnori*) which are finest on the pronotum. Punctures of the ventral surface with some appressed and decumbent, narrow, yellow scales,

In the two specimens available for study, the dorsal surface is naked except for some erect and suberect, narrow, yellow scales near the posterior and lateral margins of the elytra, but in fresh specimens the elytra probably are covered with standing scales.

Head (Figs 60 and 61) with frontal depression extending back to near the level of the posterior margin of the eye; dorsal surface of head not hollowed out immediately in front of eye; preocular margin not elevated, punctures sparsest on anterior half of head. Labrum truncate distally and about 1·5 times wider than long. Mandibles moderately arcuate; punctures very fine and sparse. Maxilla with four hooks on the galea. First segment of labial palp about three times longer than second; third segment about two times longer than wide.

Pronotum with a shallow, median groove; sides very obtusely angulate near the middle, and without a brim.

Elytral margins reflected slightly. Some of the largest punctures on each elytron are aligned and the elytra therefore appear faintly striate longitudinally.

Prosternal process flattened between coxae, very slightly convex behind coxae. First through fourth abdominal sternites less densely punctate laterally than near the middle; fifth abdominal sternite uniformly densely punctate and about 3·3 times wider than long.

Femora with moderately coarse punctures; anterior tibia (Fig. 62) somewhat arcuate, and with several small and large teeth along the outer edge; tibiae with setae and fine scales.

MALE

Length (with mandibles), 11·6 mm.; (without mandibles), 10·6 mm.: breadth, 4·8 mm.

Left mandible (Fig. 60) with a large, apical, dorsal tooth, a very small, subapical, ventral tooth (not shown in figure), and with two teeth on the medial edge. Right mandible with a bifurcate, apical tooth, a small, subapical, dorsal tooth, and with one large tooth on the medial edge. Terminal segment of maxillary palp about 3·0 times longer than wide.

Male Genitalia (Fig. 132). Resembling those of *reticulatus* except that the papilla is very greatly reduced, the ventral pair of sclerites on the everted sac is very small, slender, and distant from the papilla, and there are differences in the shape of the sclerites and membranous cushions of the penis. Ninth abdominal segment as in Fig. 137.

FEMALE

Length (with mandibles), 11·5 mm.; (without mandibles), 10·8 mm.: breadth, 4·6 mm.

Mandibles (Fig. 61) with a strong, apical tooth; right mandible with a small, subapical, dorsal tooth and with a bilobed tooth on the medial edge; left mandible with two large teeth on the medial edge. Terminal segment of maxillary palp about 2·5 times longer than wide.

Female Genitalia (Fig. 144). These resemble the genitalia of *planus* except that the spermathecal gland arises at the base of the spermatheca and the spermatheca does not have a bulbous structure at its base.

Type male and allotype female in the Brookes Collection at Plant Diseases Division, D.S.I.R., Auckland.

Variation.—Not determined.

Distribution.—This species is known so far only from the holotype and allotype, both of which were collected in North Auckland.

Biology.—Not known.

SPECIMENS EXAMINED

NORTH ISLAND.—AUCKLAND: Holotype ♂, allotype ♀, Oruru, Mangonui, 6.IX.1918, A. E. Brookes (PDD).

Lissotes oconnori n.sp.

Figs 63, 64, 133, 138

This species is known only from the male. In size and general external appearance it closely resembles *stewarti* and *mangonuiensis;* it is most easily identified by the shape of the mandibles and frontal depression, and by the very distinctive genitalia.

MALE

Length (with mandibles), 11·4 to 11·8 mm.; (without mandibles), 10·3 to 10·5 mm.: breadth, 4·8 to 5·0 mm.

Body small, reddish-brown, moderately glossy; dorsal and ventral surfaces almost uniformly covered with dense, moderately coarse, circular punctures (coarser than in *mangonuiensis,* finer than in *stewarti*). Punctures on the ventral surface bearing appressed scales and setae; punctures of dorsal surface naked except for those on the sides and posterior extremities of the elytra which bear erect and suberect, yellow, narrow scales, but fresh specimens possibly bear standing scales on the entire surface of the elytra and pronotum.

Head (Fig. 63) with the frontal depression extending back to near the level of the anterior margin of the eye; posterior half of head convex in the middle; punctures along medial edge of eye very much larger than those elsewhere on the dorsal surface of the head. Labrum rounded distally and about 1·1 times wider than long. Mandibles moderately arcuate laterally, wide at the base, finely and sparsely punctate; each mandible with a strong, apical tooth and with a dorsal, subapical tooth; left mandible with three teeth on the medial edge; right mandible with a large, bilobed tooth and a large undivided tooth on the medial edge. Maxilla with three hooks on the galea; terminal segment of maxillary palp about three times longer than second; third segment about two times longer than wide.

Pronotum without a median groove; sides very obtusely angulate near the middle and without a brim.

Elytral margins not reflected. There are three indistinct, smooth, very narrow, longitudinal ridges on each elytron.

Prosternal process flattened between and behind coxae. First through fourth abdominal sternites with punctures mainly on the middle third; fifth abdominal sternite uniformly punctate and about 3·1 times wider than long.

Femora very coarsely punctate; anterior tibia (Fig. 64) setose, and with a small angulation proximally on the inner edge; middle and hind tibiae with setae and numerous scales.

Male Genitalia (Fig. 133). Permanently everted internal sac moderately small, slender, without a papilla; with a pair of colourless, membranous triangular lobes near the middle; ventral pair of sclerites small, slender, and feebly pigmented; distal, dorsal pair of sclerites small; distal third of sac, except for a membranous median strip on the ventral side, with many rows of small, brown spines. The shape of the ventral sclerites and membranous cushions of the penis is shown in Fig. 133. Ninth abdominal segment as in Fig. 138.

Type material: Holotype male in the Dominion Museum, Wellington. Paratype male in the Brookes Collection at Plant Diseases Division, D.S.I.R., Auckland.

Variation.—Undetermined.

Distribution.—At the present time this species is known only from two specimens, both from the extreme north of the North Island.

Biology.—Unknown.

SPECIMENS EXAMINED

NORTH ISLAND.—AUCKLAND: Holotype ♂, Pandora Track, Spirits Bay, 30.XI.1960, under puriri log on open hillside, B. A. Holloway (DM). Paratype ♂, Pandora, Spirits Bay, —.I.1948, A. C. O'Connor (PDD).

This species is named in honour of the late Mr A. C. O'Connor, who collected the first specimen.

CERATOGNATHUS WESTWOOD

Ceratognathus Westwood, 1838, *Entom. Mag.*, 5: 260–261. Type species: *Ceratognathus niger* Westwood, by original designation. Burmeister, 1847, *Handb. Ent.*, 5: 324–327. Lacordaire, 1856, *Hist. nat. Insectes. Gen. Coléopt.*, 3: 41–42. Benesh, 1960, *Coleopt. Catal.*, pt. 8 (Ed. sec.): 18 (synonymy).

Platycerus Castelnau, 1840 (nec Geoffroy, 1762 and 1800; nec Muller, 1764; nec Latreille, 1807), *Hist. nat. Coléopt.*, 2: 174. Type species: *Platycerus furcatus* Castelnau (monobasic).

Mitophyllus Parry, 1845, *Trans. ent. Soc. Lond.*, 4: 55–56. Type species: *Mitophyllus irroratus* Parry (monobasic).

Ptilophyllum Guérin-Méneville, 1845, *Rev. Zool. Soc. Cuvier.*, p. 439. Type species: *Ptilophyllum godeyi* Guérin-Méneville, by original designation.

Range.—Australia, Tasmania, and New Zealand (including Chatham Islands).

When Westwood established this genus on the basis of the single species known to him, he stated that it had affinities with *Ceruchus* Macleay, but differed in the structure of the mandibles and antennae. Lacordaire (1856) separated the two genera on the form of the antennal club, which, he stated, in *Ceruchus* was composed of short, obtuse segments in contrast to that of *Ceratognathus,* in which the segments were long and filiform. The New Zealand species of *Ceratognathus,* while forming a compact group which shows close affinities with the type species (from Australia), exhibit pronounced diversity in the form of certain morphological structures, including the mandibles, antennal club, eyes, and anterior tibiae. The antennal club of males of the New Zealand species is particularly variable, and ranges in shape from stout and compact (about 1·2 times wider than deep), with broad, flattened segments in *cylindricus* (Broun), to very slender (about 10·0 times deeper than wide) and with filiform segments in *macrocerus* Broun. From the redescription of *Ceruchus* given by Arrow (1950) and based only on external morphological characters, it would appear that *Ceratognathus* is indistinguishable from *Ceruchus,* but examination of the male genitalia of these two genera has shown that they do not seem to belong to the same subfamily (Holloway, 1960). To the writer's knowledge, the most distinctive external character for separating the two genera is the form of the antennal club; in the New Zealand species, and probably also in all the Australian and Tasmanian species of *Ceratognathus,* the club segments are more or less uniformly setose, whereas it appears that in *Ceruchus* the club segments are always sharply divided into a proximal, naked, non-sensory part and a distal, setose, sensory part.

Eleven species of *Ceratognathus* are at present known from the New Zealand area; one of these is endemic to the Chatham Islands. They are small to moderately large-sized beetles in which allometry is never very pronounced. Sexual dimorphism is slight in one species (*cylindricus*) but is conspicuous in the remaining New Zealand species, affecting mainly the head and fifth abdominal sternite. The body is somewhat convex above and parallel-sided. The cuticle is either black or a shade of brown and always has some punctures bearing setae and scales that are arranged more or less characteristically for each species. Since the vestiture is easily abraded in some species, it has limited taxonomic value.

The head is short and broad in males and in females of all the New Zealand species except *dispar* Sharp, *gibbosus* Broun, and *macrocerus,* which have elongate, narrow heads. There is no canthus. The relative size of the eyes is very variable interspecifically, and within a given species the eyes of females tend to be considerably smaller than those of males. The postocular margin may be convex but is not spiny or lobate. There is a distinct labrum which appears to be immovable. The mandibles are porrect, asymmetrical, and capable of interlocking distally. They always bear some long setae. The mandibles of females of all the New Zealand species are very similar; they are small, shallow dorsoventrally, with a sharp, apical

tooth directed inwards and with a small, subapical, dorsal tooth which generally is horizontal; the left mandible has also a very small, subapical, ventral tooth. In males of all the New Zealand species except *cylindricus* the mandibles are relatively larger than those of females, and, in spite of the large amount of intraspecific variation they exhibit in the development of teeth and lobes, they are very useful taxonomically; horizontal and vertical lobes generally are present on the external edge of the mandible, and in several species dorsal, vertical teeth also are present. The maxilla of *alboguttatus* Bates, shown in Fig. 15, is typical of the New Zealand species; the lacinia and galea lack hooks. Except for *cylindricus,* in which the maxillae of males and females are identical, the maxillary palp and galea of females are shorter than those of males. The second segment of the maxillary palp varies from slightly longer to slightly shorter than the third; in some species there is intraspecific variation in the lengths. The terminal segment of the maxillary palp is never dilated and, with the exception of *cylindricus,* is shorter in females than in males. The labium of *alboguttatus* (Fig. 19) is characteristic of the New Zealand species. The mentum is small and does not cover the base of the first segment of the labial palp. The ligula is very small and does not extend beyond the first segment of the labial palp; in *alboguttatus, parrianus* (Westwood), *gibbosus, irroratus* (Parry), *insignis* (Broun), and *foveolatus* Broun it is notched distally; in *cylindricus, dispar, macrocerus,* and *reflexus* (Broun) it is undivided; in *helotoides* Thomson it is entire in the female and notched in the male. The labial palp is slender and, except for *cylindricus,* in which the palps are similar in both sexes, the segments are relatively shorter in females; the second segment is slightly longer than the first and the terminal segment is long and slender.

The antennae are short and not geniculate (see Fig. 2). The scape is slender, strongly arcuate, moderately setose, and one-quarter to one-third the length of the entire antenna. The club is composed of three uniformly setose segments; in *cylindricus* the club is similar in both sexes, but in the remaining New Zealand species the antennal club of females is smaller than that of males and has shorter, sparser setae. The seventh antennal segment has a variably-developed tubercle on the medial edge and in some species the sixth segment also is tuberculate.

The pronotum exhibits sexual and interspecific variation in the development of tubercles and other raised areas on the disc, and in the form of the brim. The front and hind angles show pronounced intraspecific variation in their development. In most species the sides of the pronotum have a narrow, serrated rim. Scutellum small, 0·9 to 1·3 times wider than long and very variable intraspecifically; distal angle obtuse. Elytra together 1·1 to 1·4 times the width of the pronotum; in *gibbosus* the shoulders and sutural margins are prominently elevated, but in other New Zealand species they are not raised. Prosternal process very narrow and not extending ventrally as far as procoxal process (see Fig. 9). Mesosternal process narrow; tuberculate in some species. Wings fully developed. Fifth abdominal sternite of females with the distal margin truncate to strongly convex; in males it is shorter and the distal margin is slightly convex to emarginate.

Legs varying interspecifically from long and slender to moderately short and stout, but of approximately equal size in a given species. Procoxal process (Fig. 9)

well developed. Femora with moderately dense punctures which bear setae or scales. Tibiae with setae, and scales when present, arranged in approximately seven shallow, longitudinal grooves. Outer edge of anterior tibia with a large tooth at the distal end and a large tooth near the middle; remainder of outer edge with many small teeth which are variable in size in *helotoides* and *cylindricus,* uniform in size in the other New Zealand species. Middle and hind tibiae generally with a few small spines on the outer edge and several spines at the distal end. Fore tibia with one large, conical spur; middle and hind tibiae each with one large and one small, conical spur. Tarsi slender; each has a well-developed arolium with two bristles, the entire arolium projecting beyond the fifth tarsomere. First through fourth tarsomeres with setae on their distal edge; in a few species the entire ventral surface of some tarsomeres is setose.

MALE GENITALIA

The most characteristic features of the male genitalia of *Ceratognathus* (based on the type species and all the New Zealand species) are the very long, slender parameres, the small or indistinguishable basal piece, the absence of struts on the penis, the elongate penis enclosed by the tegmen, and the armed, eversible internal sac. Aedeagus moderately strongly sclerotized, and symmetrical or asymmetrical depending upon the species. Penis slightly longer to slightly shorter than the tegmen, and in the form of a cylinder that is expanded proximally. Ostium terminal, dorsal or ventral, small to very large, and surrounded by sclerites in some species. Basal orifice basal or slightly dorsal. Internal sac longer or shorter than penis, and armed with pigmented or colourless spines and scales whose shape and arrangement are more or less constant intraspecifically. Tegmen composed of a small basal piece and a pair of slender, elongate, somewhat cylindrical parameres. In some species the basal piece is incompletely separated from the parameres. The shape of the parameres is diagnostic for each species.

The ninth abdominal segment is less strongly sclerotized than the aedeagus, and is symmetrical or asymmetrical depending on the species. In *gibbosus* it is asymmetrical, although the aedeagus is symmetrical. It is about 0·9 times the length of the aedeagus in all New Zealand species except *dispar* in which it is about 1·1 times longer than the aedeagus; ventral margin with a few setae distally, remainder of surface naked or with scattered short setae.

FEMALE GENITALIA

The absence of an accessory gland opening into the vagina at the level of entry of the median oviduct distinguishes *Ceratognathus* from all other lucanid genera in New Zealand. The hemisternites are moderately strongly sclerotized and pigmented, and each bears at its tip a small or large, setose stylus which shows pronounced intraspecific variation in size and shape. The spermatheca is moderately large, bulbous, straight or arcuate, colourless, not strongly sclerotized, and is annulated for part or all of its length. The spermathecal gland arises near the base of the spermatheca and is elongate and feebly sclerotized; duct annulated in most species, otherwise indistinguishable from the gland. A distinct bursa

copulatrix is absent in *helotoides* but is present in the other New Zealand species; it is small to very large, somewhat saccate, feebly sclerotized and not longitudinally folded. Spermathecal duct short to very long, soft and colourless. Bursa copulatrix, when present, connected to vagina by a short or long bursal duct which is colourless and feebly sclerotized. A large, soft, elongate sac, here regarded as an accessory gland, enters the bursal duct at the level of entry of the bursa copulatrix. In *helotoides,* in which there is no bursa copulatrix, the spermathecal duct enters the base of the accessory gland and from this junction a broad common duct (? bursal duct) is continuous with the vagina.

In the type species the female genitalia closely resemble those of *helotoides* but have a small swelling, which may represent a bursa copulatrix, at the junction of the spermathecal and accessory glands.

The following is a list of the New Zealand species of *Ceratognathus* recognized in the present paper, together with newly established synonymies. In early catalogues of the Lucanidae (Roon, 1910; Didier and Séguy, 1953) some of the species were referred to *Mitophyllus* Parry, but this genus was recently reduced to synonymy by Benesh (1960).

alboguttatus Bates
= *Ceratognathus fusculus* Broun
= *Mitophyllus cristatellus* Broun
cylindricus (Broun)
dispar Sharp
= *Mitophyllus angusticeps* Broun
= *Mitophyllus comognathus* Broun
= *Mitophyllus mandibularis* Broun
foveolatus Broun
gibbosus Broun
= *Mitophyllus tuberculatus* Broun
helotoides Thomson
insignis (Broun)
irroratus (Parry)
= *Mitophyllus curvidens* Broun
macrocerus Broun
parrianus (Westwood)
reflexus (Broun)

KEY TO THE NEW ZEALAND SPECIES OF *Ceratognathus* (MALES)

(1) Anterior tibia with two large teeth, and with many small teeth which are unequal in size (see Fig. 67) 10
Anterior tibia with two large teeth, and with many small teeth which are more or less equal in size (see Fig. 71) 2

(2) Middle third of elytral suture and shoulders of elytra very greatly elevated; centre of pronotal disc with two large tubercles .... *gibbosus* Broun, p. 96

Middle third of elytral suture and shoulders of elytra not greatly elevated; pronotal disc not tuberculate 3

(3) Antennal club more than five times deeper than wide and clothed with long setae (see Figs 83 and 95); width of eyes together one-third to one-half the total head width 8

Antennal club less than four times deeper than wide and clothed with short setae (see e.g. Figs 74 and 91); width of eyes together one-fifth to one-quarter the total head width (exception: *parrianus* in which combined eye width is two-fifths the head width) 4

(4) External edge of mandible uniformly convex, not lobate basally (Fig. 91) .... *dispar* Sharp, p. 93

External edge of mandible not uniformly convex, instead it is produced into a lobe which has its dorsal surface either horizontal or concave (see e.g. Figs 76–79, 82) 5

(5) Dorsal surface of elytron with several large concavities containing appressed, yellow scales; antennal club about 3·6 times deeper than wide (Fig. 80) .... *foveolatus* Broun, p. 81

Dorsal surface of elytron more or less smooth, without concavities; antennal club about two times deeper than wide (Figs 74, 85, 88) 6

(6) Width of eyes together two-fifths the total head width (Fig. 74); all the elytral scales yellowish brown and appressed .... *parrianus* (Westwood), p. 77

Width of eyes together about one-fifth the total head width (Figs 85 and 88); some of the elytral scales subdecumbent or suberect, pale yellow

	in colour, and arranged in small groups in four longitudinal rows on each elytron	7
(7)	Basal lobe on external edge of mandible narrow when viewed from above, and with the free edge strongly reflected dorsally (Figs 88 and 89)	*insignis* (Broun), p. 89
	Basal lobe on external edge of mandible broad when viewed from above, and with the free edge not strongly reflected dorsally (Figs 86 and 87)	*alboguttatus* Bates, p. 86
(8)	Width of eyes together one-half the total head width (Fig. 83); external surface of mentum with a large tubercle in the centre	*reflexus* (Broun), p. 84
	Width of eyes together one-third to two-fifths the head width (Figs 68, 69, 95); external surface of mentum either concave or slightly convex, not tuberculate	9
(9)	Elytral cuticle uniformly black; mandibles less than one-half the length of head (Fig. 95)	*macrocerus* Broun, p. 98
	Elytral cuticle reddish brown blotched with black; mandibles considerably more than one-half the length of head (Figs 68 and 69)	*irroratus* (Parry), p. 73
(10)	Cuticle black or blackish brown; pronotal disc with two tubercles immediately inside the anterior margin	*helotoides* Thomson, p. 69
	Cuticle reddish brown; pronotal disc not tuberculate	*cylindricus* (Broun), p. 91

KEY TO THE NEW ZEALAND SPECIES OF *Ceratognathus* (FEMALES)

(1)	Anterior tibia with two large teeth, and with many small teeth which are unequal in size (see Fig. 67)	9
	Anterior tibia with two large teeth, and with many small teeth which are more or less equal in size (see Fig. 71)	2

(2)	Middle third of elytral suture and shoulders of elytra very greatly elevated; centre of pronotal disc with two large tubercles	*gibbosus* Broun, p. 96
	Middle third of elytral suture and shoulders of elytra not greatly elevated; pronotal disc not tuberculate	3
(3)	Dorsal surface of each elytron with at least eight very distinct, somewhat oval concavities containing appressed, yellow scales; cuticle between concavities not squamose	*foveolatus* Broun, p. 81
	Dorsal surface of each elytron without distinct oval concavities containing yellow scales; yellow scales when present in groups are not appressed, and the cuticle between such groups is squamose	4
(4)	Anterior margin of head with a small, median, vertical tubercle	*macrocerus* Broun, p. 98
	Anterior margin of head smooth or rimmed, and not distinctly tuberculate in the middle	5
(5)	Head (Fig. 92) long and narrow, widest behind the eyes; preocular region of head long, and tapering conspicuously	*dispar* Sharp, p. 93
	Head (see e.g. Figs 75 and 84) short and broad, generally widest at the eyes; preocular region of head not very long, and not tapering conspicuously	6
(6)	External edge of mandible uniformly convex, not angulate near the base (Fig. 84)	*reflexus* (Broun), p. 84
	External edge of mandible with a small angulation near the base (Figs 70, 75, 86)	7
(7)	Large, stout beetles; length (including mandibles) at least 14 millimetres	*parrianus* (Westwood), p. 77
	Small moderately slender beetles; length (including mandibles) less than 13 millimetres	8

(8) Elytral cuticle reddish brown mottled with black .... *irroratus* (Parry), p. 73
Elytral cuticle uniformly black or brown .... *alboguttatus* Bates, p. 86

(9) Cuticle black or blackish brown; length (including mandibles) more than 10 millimetres .... *helotoides* Thomson, p. 69
Cuticle reddish brown; length (including mandibles) less than 10 millimetres .... *cylindricus* (Broun), p. 91

The female of *insignis* is unknown and therefore cannot be included in the key.

Ceratognathus helotoides Thomson

Figs 65–67, 160, 161, 194, 204–206

Ceratognathus helotoides Thomson, 1862, *Ann. Soc. ent. Fr.*, (4) 2: 434; female; original decription. Type locality: New Zealand. Parry, 1870, *Trans. ent. Soc. Lond.*, p. 99.

Sinodendron? areolatum Westwood, 1863, *Trans. ent. Soc. Lond.*, (3) 1: 430–431; pl. 14, fig. 2; female; original description. Type locality: New Zealand.

Ceratognathus areolatus (Westwood), Boileau, 1913, *Trans. ent. Soc. Lond.*, p. 268.

C. helotoides is best distinguished by its large, glossy, cylindrical, black (rarely brownish) body, and by the very spiny outer edges of the middle and hind tibiae. The colour, elytral ridges and large body size immediately separate it from *cylindricus* to which it shows much resemblance.

Dorsal surface coarsely and densely punctate except for a few smooth, elevated areas on the pronotum and head, and for four or five sparsely punctate, variably elevated, longitudinal bands on each elytron. Most of the punctures bear long, narrow, appressed, brown or pale yellow scales. Ventral surface very densely punctate, the punctures finer than those of the dorsal surface and bearing appressed or decumbent, fine, yellow scales.

Head (Figs 65 and 66) short and broad; width of eyes together one-sixth to one-fifth the width of head. Labrum broad, very setose; proximal half horizontal, distal half vertical and triangular in shape. Mandibles moderately short, not greatly curved, and without external lobes. Mentum moderately convex on the external surface. Sixth antennal segment with a small tubercle; antennal club with short setae.

Pronotum very convex dorsally and 1·5 to 1·6 times wider than head; front angles acute- to right-angled, and not extending far forward; sides slightly convex, irregularly serrated and without a brim; hind angles obtuse or right-angled, and sharp. Broad, smooth, elevated bands lacking scales occur on the disc as

follows: there is a median band on the posterior half to two-thirds of the disc, one parallel band on either side of the midline on the anterior half of the disc, a band on either side of the midline extending anterolaterally from near the middle of the hind margin for about half the length of the disc. Scutellum with fine, appressed, or decumbent scales.

Elytral shoulders rounded, not prominent; sides of elytra weakly serrated; each elytron with three or four longitudinal, raised bands in addition to the sutural band.

Part of mesosternum between anterior parts of second coxae flat or with a low, broad prominence. Metasternum with a median, shallow, broad depression on at least half of its length.

Legs stout and moderately short; femora and tibiae with slender scales; anterior tibia (Fig. 67) with the small teeth varying in size; middle and hind tibiae very convex and spiny externally, the spines large and one spine on the distal half of the middle tibia very large; third and fourth tarsomeres of middle and hind legs setose distally.

MALE

Length (with mandibles), 10·5 to 14·0 mm.; (without mandibles), 9·9 to 13·0 mm.: breadth, 3·8 to 5·4 mm.

Head widest at or behind the eyes. There is a short, variably developed, transverse ridge near the posterior margin of the head, and the entire dorsal surface anterior to this is deeply depressed. Anterior margin of head weakly trilobed, not rimmed; intermandibular projection moderately large, proximal half receding, distal half horizontal; preocular margin obtusely to acutely rounded, and moderately elevated above scape base. Scales on dorsal surface of head brown; those anterior to the transverse ridge are long, narrow, erect or decumbent; the remainder are short, appressed, and very fine. Mandibles deep dorsoventrally; each with a sharp, apical tooth directed ventromedially, a large, subapical, dorsal tooth directed medially, and a large, approximately vertical blade on the ventral side of the mandible. Ligula notched apically. Antennal club densely pubescent and 3·6 to 4·6 times deeper than wide (deepest in largest specimens).

Pronotum with prominent front angles; pronotal disc with a pair of prominent tubercles on either side of the midline immediately behind the anterior margin. Fifth abdominal sternite deeply emarginate distally and 4·3 to 4·7 times wider than long.

Male Genitalia (Figs 160, 161). Aedeagus (Fig. 160) symmetrical. Penis very broad, neither curved nor carinate; distal third colourless and feebly sclerotized; ostium terminal; basal orifice basal. Internal sac broad, as long as penis; proximal third with a few very fine, colourless microtrichia; middle third with dense, dark brown scales (see Fig. 161), the narrow, elongate scales least numerous; distal third with very dense, colourless, fine microtrichia which are slightly larger than those on the proximal third. The tips of the microtrichia and scales are directed proximally when the internal sac is everted. There are a few coils of the ejacula-

tory duct in the base of the penis. Parameres completely separated from the basal piece and articulating dorsally on the penis; medial edge slightly concave; dorsal surface approximately horizontal; ventral surface concave proximally, horizontal distally; tips soft, colourless and with a few setae. Ninth abdominal segment (Fig. 194) symmetrical.

FEMALE

Length (with mandibles), 11·8 to 14·5 mm.; (without mandibles), 11·1 to 13·7 mm.: breadth, 4·6 to 5·8 mm.

Head widest behind the eyes. There is a V-shaped elevation on the midline near the posterior margin of the head, and the surface of the head in front of this is slightly depressed. Anterior margin of head slightly convex, with or without a rim; intermandibular projection not discernible; preocular margin very obtusely rounded, and slightly elevated above scape base. Scales on the middle of the head long, broad, brown or pale yellow, appressed or curved; those on anterior margin and around eyes fine, brown, and erect; remaining scales on head as in male. Both mandibles with a subapical, ventral tooth. Ligula undivided. Antennal club 1·5 to 2·0 times deeper than wide.

Pronotum not tuberculate, but in some specimens the surface is slightly convex in a position that corresponds with the tuberculate region of the male. Fifth abdominal sternite truncate or slightly convex distally and 3·0 to 3·2 times wider than long. One of the spines on the distal end of the hind tibia is truncate and very elongate.

Female Genitalia (Figs 204–206). Styli (Figs 205, 206) very variable in shape, 1·0 to 1·3 times longer than wide; internal and external angles acute to obtuse and either angular or rounded; distal edge slightly convex. Bursa copullatrix absent.

Type material: Location of type of *helotoides* and type of *areolatum* Westwood unknown.

Geographic variation.—In the specimens examined local variation is very marked and geographic variation is not discernible. Although body size tends to vary a great deal in specimens from the same locality, and the number of specimens from the North Island is small, it may be significant that the largest specimens in the material examined are from the North Island and the smallest are from the South Island. In the specimens available for study the most striking individual variation is in the size, colour, and arrangement of scales on the elytra and pronota: specimens from the same locality may have numerous broad, pale yellow scales and scattered narrow, brown scales, or they may have small groups of broad, yellow scales and numerous narrow, brown scales, or all of the scales may be narrow and brown.

Distribution.—*C. helotoides* appears to be the most widespread lucanid in the New Zealand region; its present known range extends from the central part of the North Island to the southern end of the South Island. This species also occurs on the Chatham Islands, approximately 460 miles east of New Zealand.

Biology.—Brief notes indicating the habits of adults of this species accompany two of the specimens examined, a male and a female. These specimens were collected in April, 1926 boring into a power line pole in Christchurch. Several males among the material studied have the subapical, dorsal tooth of the mandible conspicuously worn down from above, which is further evidence of wood-boring activities. Whether the two specimens referred to above were boring in the same tunnel is not known. Perhaps males and females of this species work together to construct oviposition tunnels, females doing most of the boring and males perhaps being responsible for clearing the wood particles from the tunnels. The head and mandibles of the male of *helotoides* together appear to form a scoop which would be well suited to pushing debris out of a tunnel; the mandibles are very deep dorsoventrally and when open could form the front half of the scoop; the depression in the dorsal surface of the head could form the posterior half of the scoop. The small, sometimes overhanging ridge behind the depression on the and the two tubercles on the anterior part of the pronotum perhaps serve to prevent the load from being pushed back over the body as the beetle moves forward. The dorsal, subapical, mandibular tooth is the only tooth which is worn down and this wear must have occurred through contact from above, presumably from the roof of the tunnel. The head of the female is much less adapted as a scoop, since it is only slightly depressed on the dorsal surface and the mandibles are shallow dorsoventrally; there are no pronotal tubercles. From the information accompanying the specimens it appears that adults occur throughout the year.

Synonymy.—The type of *helotoides* has not been examined by the writer but the original description is sufficiently detailed to permit the recognition of the species. The type of *areolatum* Westwood has not been seen by the writer but Westwood's description and figures indicate without any doubt that the specimen is a female of *helotoides*.

SPECIMENS EXAMINED

NORTH ISLAND.—AUCKLAND: 3 ♂, 2 ♀, Tokaanu, —.IV.1918, A. C. O'Connor (DM). 3 ♀, same locality and collector, 1918 (DM). 1 ♂, Tokaanu, 6.IV.1918, coll. ? (PDD). 1 ♀, Gisborne, —.IV.1942, M. Laird (DM).
SOUTH ISLAND.—NELSON: 2 ♂, Motupiko, 30.IX.1934, G. Hole (EG). 1 ♂, MacKay's Bluff (2,000 ft), 8.XI.1944, E. S. Gourlay (EG). 1 ♂, Mt. Arthur Tableland, 28.XII.1889, G. V. Hudson (BMNH). WESTLAND: 3 ♂, 1 ♀, Waiho Gorge, 15.I.1925, coll. ? (AM). 5 ♂, Waiho Gorge, 16.I.1925, coll. ? (AM). 1 ♂, Waiho Gorge, 15.I.1925, C. E. Clarke (PDD). CANTERBURY: 1 ♀, Akaroa, no other data (PDD). 2 ♂, Cass, —.VI.1918, Lindsay (CM). 1 ♂, Mt. Grey, 25.XII. 1916, Lindsay (CM). 1 ♂, Otarama, 22.X.1921, coll. ? (CM). 1 ♀, Otarama, 17.X.1921, G. Archey (CM). 1 ♀, Purple Peak, Akaroa, 25.XII.1945, C. E. Clarke (AM). 7 ♂, 5 ♀, Governor's Bay, Christchurch, no date, Tapley (CM). 1 ♀, same locality, 13.IX.1923, Lindsay (CM). 1 ♂, Christchurch, boring in electric pole, —.IV.1926, A. Tonnoir (CM). 1 ♀, same data (PDD). OTAGO: 3 ♂, 1 ♀, Mt. Maungatua, Taieri, 24.X.1921, coll. ? (AM). 1 ♂, Dart Valley, 5.X..1946, G. Gibbs (DM). 2 ♂, 3 ♀, Otago, 1946, Raymond Coll. (DM).

CHATHAM ISLANDS.—Mangere I.: 2 ♂, 1 ♀, 4–21.I.1924, C. Lindsay (CM). Pitt I.: 2 ♂, 1 ♀, 16–26.I.1944, E. S. Gourlay (EG). Chatham I.: 1 ♂, Wangamarino, 27–28.I.1928, C. Lindsay (CM). 1 ♂, Kaingaroa, 25.XII.1923, C. Lindsay (CM). 1 ♀, Chatham I., 28–30.I.1944, E. S. Gourlay (EG). 1 ♀, Chatham I., —.VI.1931, G. H. Gubbins (EG). 1 ♂, same data (AM). 1 ♂, Chatham I., —.I.1911, A. Hamilton (DM). 1 ♂, Chatham I., —.I.1938, N. G. Mitchell (EG). 2 ♂, Chatham I., no other data (CM).

Ceratognathus irroratus (Parry)

Figs 68–73, 162–164, 195, 207

Mitophyllus irroratus Parry, 1845, *Trans. ent. Soc. Lond.*, 4: 56; pl. 1, fig. 4; male; original description. Type locality: Port Nicholson, New Zealand. White. 1846, *Voy. Erebus and Terror. Insects,* p. 9; pl. 2, figs 3, 4.

Ptilophyllum Godeyi Guérin-Méneville, 1845, *Bull. Soc. ent. Fr.*, (2) 3: 97; male; original description. Type locality: New Zealand. Guérin-Méneville, 1845, *Rev. Zool. Soc. Cuvier.*, p. 439.

Mitophyllus curvidens Broun, 1904, *Ann. Mag. nat. Hist.*, (7) 14: 50–52; male, female; original description. Type locality: Karori (Wellington), New Zealand. NEW SYNONYMY.

Ceratognathus irroratus (Parry), Benesh, 1960, *Coleopt. Catal.*, pt. 8 (Ed. sec.): 20–21.

This species is best distinguished by its small, slender form and by the black, somewhat iridescent blotches which are present on the dorsal surface of the body. The general colour of the beetle is reddish-brown. The black blotches are devoid of vestiture but the remainder of the dorsal surface has small, narrow, yellowish-brown, appressed scales. *C. irroratus* shows some resemblance to both *parrianus* and *reflexus,* but the small, slender body immediately separates it from *parrianus* and the mottled elytra separate it from *reflexus.*

Entire dorsal surface with small, dense punctures. The elytra and pronotum have small groups of very pale yellow, broad, appressed or decumbent scales in addition to the appressed, yellowish-brown scales. Ventral surface light- or dark-reddish, glossy, and with moderately dense, small punctures; punctures on the metasternum and abdomen with short, appressed, yellowish-brown scales which are very fine in the vicinity of the midline, broader elsewhere; remainder of ventral surface with appressed, fine setae.

Head (Figs 68–70) moderately short and broad, widest at the eyes; anterior half of dorsal surface flattened or slightly concave; remainder of dorsal surface convex and with a small, irregular elevation on the midline between or behind the eyes. There are a few semierect scales near the eyes, but most of the scales on the dorsal surface of the head are appressed and arranged in the form of the letter M between the eyes and extending forward to the anterior margin. Intermandibular projection very small, receding; preocular margin of head truncate

to obtusely rounded, and moderately strongly raised above scape base. Labrum short, narrow, setose, directed anteroventrally and emarginate or convex on the distal edge. Mentum concave medially on the external surface; ligula divided.

Pronotum moderately convex dorsally; front angles acute- to right-angled, and not extending far forward; hind angles obtuse, sharp but not prominent; sides convex near the middle, finely and evenly serrated, not reflected. On the posterior half the disc there is a narrow, black band on the midline and a large black area on either side of the midline. On the anterior half of the disc there are two small, black areas on either side of the midline. There is a small cluster of pale scales in the hind angles, and along the posterior margin there is a similar group of scales on either side of the midline. Scutellum with dense appressed scales.

Elytral shoulders rounded, not prominent; sides of elytra very weakly serrated; sutural margin slightly raised. Black, oval areas, devoid of scales and setae, are arranged in five rows on each elytron, with three to seven oval areas in a row. The cuticle between the longitudinal rows bears appressed yellowish-brown scales; that between the oval areas within each row bears tufts of pale, decumbent scales.

Mesosternum with or without a small tubercle between the anterior parts of the second coxae. Metasternum with a broad, shallow depression near the middle.

Legs long and slender; femora with long, fine, appressed scales; tibiae with setae and fine scales; anterior tibia (Fig. 71) with the small teeth approximately equal in size; middle and hind tibiae moderately convex externally and with a few small spines; middle tibia with a large spine near the middle; third and fourth tarsomeres of middle and hind legs entirely setose ventrally.

MALE

Length (with mandibles), 9·1 to 13·0 mm.; (without mandibles), 8·2 to 12·0 mm.: breadth, 3·3 to 5·0 mm.

Anterior margin of head not rimmed; width of eyes together two-fifths the width of head. Two distinct mandibular forms, without intergrades, occur, and these forms are not dependent upon any particular body size. In one form (Figs 68, 72) the mandibles are deep dorsoventrally and not arcuate laterally; there is a strong, apical tooth directed anteromedially, a very large, subapical, vertical, dorsal tooth, a sharp, approximately horizontal tooth externally near the base of the mandible, one or two very small teeth ventrally on the medial edge near the base of the mandible, and a broad, horizontal, ventral lamina extending from near the apical tooth for two-thirds the length of the mandible. In the other form (Figs 69, 73), the mandibles are shallow dorsoventrally and strongly arcuate laterally; there is a strong, apical tooth directed anteromedially, a small, subapical, ventral tooth, two moderately large, vertical, dorsal, subapical teeth, a rounded, reflected lobe externally near the base of the mandible, and three blunt teeth medially at the base of the mandible. Antennal club 6·5 to 7·0 times deeper than wide, and with very long, dense setae.

Pronotum 1·3 to 1·4 times wider than head; brim moderately broad. Fifth

abdominal sternite 3·8 to 4·0 times wider than long, and with the distal edge truncate or shallowly emarginate.

Male Genitalia (Figs 162–164). Aedeagus (Fig. 162) symmetrical. Penis narrow; dorsal surface strongly concave near the middle; ventral surface approximately horizontal; ostium ventral; basal orifice basal. Internal sac broad and about four-fifths the length of penis; proximal two-fifths of sac with a few small, colourless scales (Fig. 163); remainder of sac with dense, brown scales (Fig. 164). When the sac is everted the tips of the scales are directed towards the proximal end of the sac. Parameres completely fused with basal piece and articulating dorsally on the penis; tips of parameres curving slightly dorsally. Ninth abdominal segment (Fig. 195) symmetrical.

FEMALE

Length (with mandibles), 9·7 to 12·2 mm.; (without mandibles), 9·2 to 11·5 mm.: breadth, 4·0 to 4·7 mm.

Anterior margin of head slightly elevated; width of eyes together about one-third the width of head. Mandibles hollowed out on the dorsal surface; there are one to three small teeth along the medial edge and an approximately horizontal lobe externally near the base of the mandible. Antennal club 1·5 to 2·0 times deeper than wide, and with short, sparse setae.

Pronotum 1·6 to 1·8 times wider than head; brim narrow. Fifth abdominal sternite 2·9 to 3·5 times wider than long, and with the distal edge convex.

Female Genitalia (Fig. 207). Styli 1·5 to 2·5 times longer than wide; internal angle obtuse; external angle acute; distal edge truncate or convex. Bursa copulatrix short and broad.

Type material: location of type of *irroratus* and type of *godeyi* Guérin-Méneville unknown; type of *curvidens* Broun in the British Museum (Nat. Hist.).

Geographic variation.—There is a large amount of local variation in body size in this species. Trends in geographic variation have been discerned only in the form of the mandibles of males. The two mandibular forms appear to be allopatric; with the exception of a few specimens (in BMNH collections) stated to be from Blackball, Westland all the males with laterally arcuate mandibles are from localities north of 40° S; in the material examined, one male (in BMNH collections) with non-arcuate mandibles is stated to be from Auckland but all the other males with this type of mandible are from localities south of 41° S. Since *irroratus* is a good flier this apparent geographic separation may prove to be highly significant. The two forms of mandibles possibly result from a single gene difference since no intergradation has been observed between them.

Distribution.—*C. irroratus* is widely distributed throughout the North and South Islands of New Zealand, but has not been recorded from either the Chatham Islands or Stewart Island. Broun (1910) records this species from Sunday Island in the Kermadecs.

Biology.—The larva and pupa of this species have been described by Broun (1881) from specimens found in "*Coriaria sarmentosa* which they had destroyed."

The larva has also been described and figured by Hudson (1934) who mentions that it occurs in decayed wood under fallen logs of hinau, karaka, and other trees. Miller (1925), who erroneously refers to this species as *Mitophyllus macrocerus* Broun, mentions that both larvae and adults have been found in imported ironbark poles at Auckland. Among the material examined by the writer is a female specimen bred from timber at Auckland. The writer has observed these beetles flying during the day, and some of the males examined were collected in light traps. Adults have been collected from December through May. The mandibular teeth of the specimens examined do not show any wear.

Synonymy.—The types of *irroratus* and *godeyi* Guérin-Méneville have not been seen by the writer, but the descriptions clearly indicate that the specimens are males with non-arcuate mandibles. The type of *curvidens* Broun, which has been examined by the writer, is a male with non-arcuate mandibles.

SPECIMENS EXAMINED

NORTH ISLAND.—AUCKLAND: 1 ♂, Waipoua Forest, 1930, A. C. Forbes (DM). 1 ♀. Parua Bay, 5.I.1927, coll. ? (AM). 1 ♀, Waikarakara Valley, Parua Bay, 17.I.1927, coll. ? (AM). 1 ♀, Whangarei, 5.IV.1926, E. Fairburn (PDD). 1 ♂, Wayby Gorge, 29.XII.1926, C. E. Clarke (AM). 1 ♂, 1 ♀, Great Barrier I., no date, Lewis Coll. (DM). 2 ♀, Arid I., Great Barrier I., 17.I.1944, Major Buddle (PDD). 4 ♂, Titirangi, —.IV.1953, from light trap, C. R. Thomas (PDD). 1 ♂, Titirangi, 30.I.1953, from light trap, C. R. Thomas (PDD). 1 ♂, Titirangi, 1953, from light trap, C. R. Thomas (PDD). 1 ♂, Titirangi, 25.II.1953, from light trap, C. R. Thomas (PDD). 1 ♀, Titirangi, bred from timber collected on 10.IV.1942, emerged —.III.1943, M. W. Carter (PDD). 1 ♀, Mangamuka Gorge, Hokianga, 9.I.1927, A. Richardson (AM). 1 ♂, Mangere, 26.III.1951, K. P. Lamb (PDD). 2 ♂, 1 ♀, Purewa Bush, 20.II.1943, D. McKenzie (PDD). 1 ♂, 1 ♀, Mt. Albert, —.III.1946, T. Atkinson (PDD). 1 ♂, Owairaka, 13.V.1939, Mr Cornford (PDD). 1 ♀, Owairaka, 10.III.1943, D. McKenzie (PDD). 1 ♂, 1 ♀, Takapuna, —.I.1940, K. Harrow (PDD). 1 ♂, Mt. Roskill, 28.III.1947, A. E. Brookes (PDD). 1 ♂, Twin Bridges, 16.I.1951, D. Spiller (PDD). 2 ♂, Whirinaki Valley, Hokianga South, —.I.1957, W. Davidson (PDD). 1 ♂, Grafton Gully, 20.I.1951, D. Spiller (PDD). 1 ♂, Waiheke I., 23.XII.1942, G. Chamberlain (PDD). 1 ♂, Waiheke I., —.I.1944, G. Chamberlain (PDD). 1 ♂, 1 ♀, Little Barrier I., no date, Lewis Coll. (DM). 4 ♂, Auckland, 23.II.1940, E. S. Gourlay (EG). 3 ♂, 2 ♀, Auckland, from power pole, 7.I.1941, K. Harrow (PDD). 1 ♀, same data (AM). 1 ♀, Auckland Province, 1921, coll. ? (AM). 1 ♂, 2 ♀, Orua Bay, 5.IV.1942, J. M. Kelsey (PDD). 1 ♀, Kaimai Range, —.I.1932, A. E. Brookes (PDD). 1 ♂, Okauia, 23.I.1924, coll. ? (AM). 1 ♂, Okauia, 19.XII.1920, A. E. Brookes (PDD). 1 ♀, Okauia, 13.II.1920, A. E. Brookes (PDD). 2 ♀, Okauia, 5.III.1921, A. E. Brookes (PDD). 1 ♂, Taumarunui, 25–31.XI.1931, E. A. Plank (DM). 1 ♂, Whakatane, 14.XII.1954, P. J. Cristall (PDD). 1 ♀, Mamaku, 8.II.1929, coll. ? (AM). WELLINGTON: 1 ♂, Taihape, 25.I.1927, A. Castle (DM). 1 ♂, 1 ♀, Titahi Bay, 21.II.1909, A. C. O'Connor (DM). 1 ♀, Titahi Bay, 28.III.1909, A. C. O'Connor (DM),

1 ♂, Titahi Bay, 3.I.1909, coll. ? (DM). 1 ♂, Titahi Bay, no date, Philpott (DM). 1 ♂, Akatarawa, 14.III.1941, R. R. Forster (DM). 1 ♂, Lower Hutt, 3.IV.1960, M. Büchler (DM). 1 ♀, Makara, 20.III.1909, A. C. O'Connor (DM). 3 ♂, Wellington, no date, Lewis Coll. (DM). 1 ♀, Butterfly Creek, 4.III.1958, R. K. Dell (DM). 1 ♀, Karori, 26.XI.1918, coll. ?. (PDD). 1 ♀, Wadestown, 6.IV.1918, coll. ? (PDD). 1 ♂, Wadestown, 26.XI.1918, coll. ? (PDD). SOUTH ISLAND.—MARLBOROUGH: 1 ♂, Oaro, Kaikoura, 25.II.1947, C. E. Clarke (AM). NELSON: 1 ♂, Riwaka Valley, 28–31.I.1949, Brookes and O'Connor (PDD). 1 ♀, Aorere Valley, —.II.1949, A. E. Brookes (PDD). 1 ♂, 1 ♀, Nelson, 24.III.1928, E. S. Gourlay (EG). 1 ♀, Nelson, 24.III.1930, breeding in dead hawthorn, E. S. Gourlay (EG). 1 ♂, Westport, 20.I.1935, E. S. Gourlay (EG). CANTERBURY: 1 ♂, Governor's Bay, no date, Tapley (CM). 3 ♀, New Brighton, 20.I.1948, E. S. Gourlay (EG). OTAGO: 1 ♀, Anderson's Bay, 4.III.1915, coll. ? (AM). 1 ♀, MacLennan, 24.II.1929, coll. ? (AM). SOUTHLAND: 1 ♂, Tewaewae, 1.II.1948, J. H. Sorensen (DM).

A large series of this species in the collections of the British Museum (Nat. Hist.) includes specimens from Auckland and Wellington in the North Island, and from Picton (Marlborough) and Blackball (Nelson) in the South Island.

Ceratognathus parrianus (Westwood)

Frontispiece, 15, 16
Figs 2, 9, 74–79, 165–172, 196, 208

Mitophyllus Parrianus Westwood, 1863, *Trans. ent. Soc. Lond.,* (3) 1: 432–433; pl. 15, fig. 3; male; original description. Type locality: New Zealand.

Mitophyllus marmoratus Waterhouse, 1874, *Entom. mon. Mag.,* 11: 8; male, female; original description. Type locality: New Zealand. Boileau, 1913, *Trans. ent. Soc. Lond.,* pp. 267–268.

Ceratognathus zealandicus Broun, 1877, *Trans. Proc. N.Z. Inst.,* 9: 372–373; male; original description. Type locality not stated as such but the following localities listed: Canterbury, Stoke Point, Tairua. Broun, 1880, *Manual N.Z. Coleopt.,* pt. 1: 253 (redescription of male, description of female). Broun, 1893, *Manual N.Z. Coleopt.,* pt. 5: 1112 (lists *zealandicus* as synonym of *parrianus*).

Ceratognathus parryanus (Westwood), Benesh, 1960, *Coleopt. Catal.,* pt. 8 (Ed. sec.): 20.

This species contains the largest known New Zealand members of the genus. They are drab, reddish-black or brown beetles which have somewhat iridescent, purplish-black blotches on the elytra and pronotum. These blotches bear no vestiture; the cuticle of the remainder of the pronotum and elytra bears large, appressed, yellowish-brown scales. The coloration and vestiture of the dorsal surface in *parrianus* are similar to those in *irroratus,* but the latter has a much smaller, more slender body.

Body large and stout. Dorsal surface coarsely and moderately densely punctate. Ventral surface glossy, moderately coarsely and approximately uniformly densely punctate; punctures near the midline mainly with appressed coarse setae; remainder with short, broad, appressed, yellowish-brown scales and setae.

Head (Figs 74, 75) short and broad, with an irregular elevation on the midline between and posterior to the eyes. The elevation bears no vestiture; there are a few semierect setae near the eyes; remainder of dorsal surface of head covered with appressed scales. Intermandibular projection short, broad, almost vertical, emarginate distally; preocular margin truncate to obtusely rounded, and slightly elevated above scape base. Labrum short, narrow, very setose, almost horizontal proximally, vertical distally; distal edge angulate in the middle. Mandibles broad basally, not greatly curved; with two or three teeth on the medial edge. Labium as in *irroratus*. Sixth, and in some specimens fifth, antennal segments with a tubercle medially; antennal club with short setae.

Pronotum moderately convex dorsally; front angles acute or right-angled and extending well forward; hind angles as in *irroratus;* sides strongly convex near the middle, coarsely serrated and with a broad, horizontal brim. The dark areas lacking scales are slightly raised and have the following arrangement. There is a broad, medial band on at least the posterior half of the disc, and four to six irregularly shaped, approximately symmetrically arranged areas on the remainder of the disc. Scutellum as in *irroratus*.

Elytral shoulders, sides and sutural margin as in *irroratus*. The dark areas on each elytron are approximately oval in shape and are arranged in three distinct longitudinal rows; there are five or six dark areas in each of the two inner rows and three to five in the outermost row.

Mesosternum with a conspicuous tubercle between the anterior parts of the second coxae. Metasternum as in *irroratus*.

Legs as in *irroratus*.

MALE

Length (with mandibles), 14·0 to 20·0 mm.; (without mandibles), 12·5 to 18·0 mm.: breadth, 5·5 to 7·5 mm.

Head widest at the eyes; width of eyes together two-fifths the width of head; dorsal surface of anterior third of head flattened or slightly depressed; elevation between eyes prominent; anterior margin of head not rimmed. Mandibles not deep dorsoventrally; each with a strong, apical tooth directed anteromedially, a large, approximately vertical, subapical, dorsal tooth, one or several small, irregular teeth along the medial edge, and a large external lobe at the base of the mandible. The mandibular teeth and lobe are very variable in shape (see Figs 74, 76–79). Antennal club about 2·0 times deeper than wide, and densely pubescent.

Pronotum about 1·5 times wider than head. Fifth abdominal sternite emarginate distally and 3·7 to 3·9 times wider than long.

Male Genitalia (Figs 165–172). Aedeagus (Fig. 165) symmetrical. Penis moderately broad; dorsal surface slightly concave; ventral surface slightly convex; ostium terminal; basal orifice basal. Internal sac broad, about one-half the length of penis, and divided into three regions of approximately equal length. The proximal region is colourless and lacks armature. The middle region is densely covered with scales which are arranged as follows: there is a narrow, proximal band of short, broad, colourless, overlapping scales (Fig. 166) which are directed proximally; this region is followed by a narrow band of dense scales which are slightly smaller than those in Fig. 166; distal to this region there is an extensive zone containing dense, brown scales, most of which are curved, slender, and narrow (Fig. 167) but some are large and broad (Fig. 168), and the tips of these scales are directed medially. The distal third of the internal sac bears moderately dense, colourless scales which have their tips directed proximally, and which resemble those in Fig. 166 except that they are smaller. The male genitalia of this species were investigated by Sharp and Muir (1912) who considered the internal sac to lack armature but to be covered with fine, brown hairs. It is very likely that these authors had not completely everted the internal sac and saw only the dark brown, curved scales which are present on the middle third of the sac. Since most of the remaining scales are colourless and small they could easily be overlooked. Parameres incompletely separated from basal piece dorsally, continuous with it ventrally; medial edge concave; proximal three-fifths with a broad, dorsomedial lamina; tip of paramere directed ventromedially. The size and shape of the tips of the parameres are highly variable; some of the variations are shown in Figs 169–172. Ninth abdominal segment (Fig. 196) symmetrical.

FEMALE

Length (with mandibles), 14·5 to 19·0 mm.; (without mandibles), 13·2 to 17·6 mm.: breadth, 5·5 to 7·5 mm.

Head widest at or behind the eyes; width of eyes together one-third the width of head; dorsal surface of head flattened or slightly convex; anterior margin of head with a narrow rim on the middle half. Mandibles very concave on the dorsal surface. Antennal club about 1·3 times deeper than wide.

Pronotum approximately 2·0 times wider than head. Fifth abdominal sternite convex distally and 3·0 to 3·2 times wider than long.

Female Genitalia (Fig. 208). Very similar to those in *irroratus*. Styli variable in shape, 2·0 to 4·0 times longer than wide; internal angle acute to obtuse; external angle obtuse; distal edge slightly convex. Bursa copulatrix short and broad.

Type material: location of type of *parrianus* and of type of *zealandicus* Broun unknown; type of *marmoratus* Waterhouse in the British Museum (Nat. Hist.).

Geographic variation.—This species exhibits a considerable amount of local variation in many characters, e.g., body size, extent of non-squamose areas, shape of scales, shape of parameres, size and shape of teeth and lobes on the mandibles,

The writer has not detected any geographic variation in the large series of specimens examined. It may be significant that, in the material examined, the longest styli occur in females from the Stewart Island area.

Distribution.—*C. parrianus* is widespread throughout New Zealand where it occurs from sea-level to at least 4,000 feet. There are no records of its occurring on the Chatham Islands.

Biology.—The larva has been figured by Hudson (1934) who states that it feeds in dead branches of kohe kohe, *Carpodetus serratus* J. R. & G. Forst. and probably other small trees. Hudson mentions that adults spend the winter in sealed tunnels in branches of kohe kohe (*Dysoxylum spectabile* Hook. f.). Notes accompanying several of the specimens examined by the writer indicate that adults may be found in telegraph poles and fallen logs, and that males are sometimes attracted to light traps. The mandibular teeth are not worn down in any of the specimens seen by the writer.

Synonymy.—The type of *parrianus* is not known to the writer but the species is easily recognized from Westwood's original description and figure. The type of *marmoratus* Waterhouse falls well within the range of variation shown by *parrianus*. The type of *zealandicus* Broun is not in the Broun Collection at the British Museum (Nat. Hist.) but since Broun himself eventually synonymized *zealandicus* with *parrianus* he may have discarded the type.

SPECIMENS EXAMINED

NORTH ISLAND.—AUCKLAND: 1 ♀, Waipoua Forest, 1930, A. C. Forbes (DM). 1 ♂, 2 ♀, Western Hills, Whangarei, 21.V.1927, E. Fairburn (CM). 1 ♂, Waitakere Ra., 14.III.1939, K. Harrow (PDD). 1 ♂, Titirangi, 1945, M. W. Carter (PDD). 1 ♂, Titirangi, 22.I.1953, C. R. Thomas (PDD). 1 ♂, Oratio, 6.II.1941, D. Drake (PDD). 1 ♂, Auckland, 1928, C. E. Clarke (PDD). 1 ♂, Waiheke I., 12.XII.1949, G. Chamberlain (DM). 1 ♂, 1 ♀, Waiheke I., 16.VIII.1943, G. Chamberlain (PDD). 1 ♀, Tauranga, 20–26.III.1931, E. S. Gourlay (EG). TARANAKI: 1 ♂, Okato, no date, Hutton Coll. (CM). WELLINGTON: 1 ♂, 1 ♀, National Park, 24.XII.1939, A. Richardson (AM). 1 ♂, 1 ♀, Ohakune, 10.III.1920, M. Harris (AM). 1 ♀, Ohakune, 23.II.1927, A. Castle (DM). 1 ♂, Karioi, no date, E. Fairburn (DM). 1 ♀, Bulls, 25.IV.1944, Major Wilson (PDD). 1 ♂, Mt. Holdsworth, 4.II.1919, H. W. Simmonds (DM). 1 ♂, Kaitoke Reserve, 19.I.1959, R. G. Ordish (DM). 3 ♂, 3 ♀, Upper Hutt, 9.II.1913, A. C. O'Connor (DM). 1 ♀, Moonshine, —.II.1907, A. C. O'Connor (DM). 2 ♂, Paekakariki, 25.VIII.1941, D. Hunt (CM). 1 ♀, Paekakariki Hill, 9.IX.1941, D. Hunt (CM). 2 ♂, 6 ♀, Wadestown, 1916, A. C. O'Connor (DM). 2 ♂, 2 ♀, Khandallah, 12.V.1949, G. Ramsay (DM). 4 ♀, Khandallah, 11.IX.1949, G. Ramsay (DM).

SOUTH ISLAND.—NELSON: 1 ♀, D'Urville I., Cook Strait, 14.I.1931, E. Fairburn (DM). 1 ♀, D'Urville I., 13–17.I.1931, E. S. Gourlay (EG). 1 ♀, same locality and collector, 20–24.I.1946 (EG). 1 ♂, MacKays Bluff (2,000 ft), 8.XI.1944, E. S. Gourlay (EG). 2 ♀, Motupiko, 18.IV.1949, G. Ramsay (DM). 1 ♂, Wairoa Gorge, 25.X.1931, E. S. Gourlay (EG). WESTLAND: 1 ♂, Grey-

mouth, 6.I.1945, E. Fairburn (DM). 1 ♀, Hende's Ferry, —.XII.1915, J. Hende (CM). CANTERBURY: 1 ♀, Peel Forest, 7.II.1946, R. R. Forster (DM). 1 ♀, Riccarton Bush, 4.XII.1941, E. S. Gourlay (EG). OTAGO: 1 ♀, Makarora, N. Lake Wanaka, 5.I.1924, coll. ? (AM). 1 ♂, Waitati, 6.XII.1916, C. E. Clarke (AM). 1 ♀, Hoopers Inlet, 8.VI.1913, C. E. Clarke (AM). 1 ♂, Worsley Arm, Lake Te Anau, 29.XII.1924, A. Richardson (AM). 1 ♂, Hope Arm, Lake Manapouri, 4.I.1923, coll. ? (AM). SOUTHLAND: 1 ♂, Tewaewae Beach, 14.II.1947, C. E. Clarke (AM).

STEWART ISLAND.—1 ♀, Easy Cove, 26.I.1955, R. K. Dell and B. A. Holloway (DM). 1 ♀, Solomons I., 25.I.1955, R. K. Dell and B. A. Holloway (DM). 2 ♀, Big South Cape I., 24.I.1955, R. K. Dell and B. A. Holloway (DM).

Ceratognathus foveolatus Broun

Frontispiece, 19
Figs 80–82, 173, 174, 197, 209

Ceratognathus foveolatus Broun, 1880, *Manual N.Z. Coleopt.*, pt. 1: 253–254; male; original description. Type locality: mountainous region near Nelson, New Zealand.

This species is easily recognized by its large, glossy, blackish body with many large, very distinct groups of pale or dark yellow, appressed scales in cuticular depressions on the dorsal surface. Since the scales are in depressions they are not easily abraded. *C. foveolatus* resembles *parrianus* in size, but the two species are readily distinguished by their coloration.

Body large and stout. Dorsal surface black or reddish-black, and somewhat iridescent in some specimens; scales arising from coarse punctures; cuticle between groups of scales elevated, devoid of vestiture, and with small to moderately large punctures which are irregularly and never densely arranged. Ventral surface brownish-black; sides of metasternum and of first through fourth abdominal sternites with a broad band of pale scales arising from coarse punctures; remainder of ventral surface with appressed or decumbent, fine setae which arise from moderately coarse, usually sparse punctures.

Head (Figs 80, 81) short and broad, and with an approximately V-shaped elevation between and posterior to the eyes. There are a few appressed scales near the anterior margin, and many appressed scales arranged in the form of the letter M between and behind the eyes; near the eyes there are a few semi-erect setae. Anterior margin of head slightly wavy or emarginate, elevated at base of mandibles, not rimmed; intermandibular projection short, broad, truncate, and directed anteroventrally; preocular margin truncate or obtusely rounded, and very slightly elevated above scape base. Labrum as in *parrianus*. Mentum short, truncate, or slightly rounded distally; ligula notched. Sixth antennal segment with a tubercle medially; antennal club with short setae.

Pronotum very convex dorsally; front angles obtuse or right-angled and not extending forward far; hind angles and sides as in *parrianus*, except that the brim is narrower. There are a few submarginal scales anteriorly, a large group of scales in each of the fore and hind angles, a median, triangular group of scales on the anterior half of the disc, and a broad band of scales on either side of the midline on the posterior half of the disc. Scutellum as in *parrianus*.

Elytral shoulders and sides as in *irroratus*. There are a few slender scales along the sutural margin and near the outer edge of the elytron but most of the scales are in isolated, depressed, approximately oval groups arranged in four longitudinal rows on each elytron; there are three to seven groups in the row nearest the suture, four to five in the next outermost row, three to five in the next row, and four to six narrow groups in the outermost row.

Mesosternal tubercle and metasternal depression as in *parrianus*.

Legs as in *irroratus* except that the femora and tibiae bear numerous setae and a few fine scales, and that the third and fourth tarsomeres of the middle and hind legs bear submarginal setae only.

MALE

Length (with mandibles), 11·6 to 14·5 mm.; (without mandibles), 10·5 to 12·5 mm.: breadth, 4·8 to 6·0 mm.

Head widest at or behind the eyes; width of eyes together one-fifth to one-quarter the width of head. Mandibles similar to those in *parrianus* except that there are two to four teeth along the medial edge, and that the external lobe at the base of the mandible tends to be more prominently reflected dorsally. There is a large amount of individual variation in the size and shape of the teeth and external lobe of the mandible (compare Figs 80 and 82). Antennal club densely pubescent and about 3·6 times deeper than wide; fourth and fifth antennal segments tuberculate medially in some specimens.

Pronotum 1·6 to 1·8 times wider than head. Fifth abdominal sternite emarginate distally, and about 3·9 times wider than long.

Male Genitalia (Figs 173, 174). Aedeagus (Fig. 173) symmetrical. Penis slender; dorsal surface concave, slightly carinate near the middle, and with a prominent, hooked tooth distally; ventral surface convex; ostium terminal but somewhat dorsal, and surrounded by a large, ventral, chitinous lobe and by two smaller, dorsal, chitinous lobes which are separated by a medial, membranous area; basal orifice basal. Internal sac broad, and about two-thirds the length of penis; proximal third colourless and without armature; middle third bearing dense brown scales (Fig. 174) which have their tips directed toward the proximal end of the sac; distal third with colourless, dense, small scales (about half the size of the smallest scales on the preceding section) which have their tips directed medially. Parameres completely separated from basal piece and articulating dorsally on penis; proximal third of each paramere concave on the medial surface; distal two-thirds of paramere compressed dorsoventrally; tip greatly expanded, feebly sclerotized, and almost colourless. Ninth abdominal segment (Fig. 197) symmetrical.

FEMALE

Length (with mandibles), 13·0 to 15·0 mm.; (without mandibles), 12·0 to 14·0 mm.: breadth, 5·5 to 6·5 mm.

Head widest behind eyes; width of eyes together one-sixth to one-quarter the width of head. Mandibles as in *parrianus*. Antennal club about 1·2 times deeper than wide.

Pronotum 1·9 to 2·1 times wider than head. Fifth abdominal sternite about 3·2 times wider than long; truncate to slightly convex on the distal margin.

Female Genitalia (Fig. 209). Styli 1·0 to 1·2 times longer than wide; internal angle obtusely rounded; external angle acute; distal edge convex. Bursa copulatrix very short and moderately narrow.

Type: Location of type not definitely known. Broun described this species from a male minus legs and antennae. There are three specimens in his collection at the British Museum (Nat. Hist.) but none is the type. The A. E. Brookes Collection housed at the Plant Diseases Division, D.S.I.R., Auckland contains a male specimen of *foveolatus* which is minus legs and antennae, and which fits Broun's description of the type. The specimen bears the number "448" which is the number that *foveolatus* is given in the Broun Manual, and it also bears a handwritten locality label "Nelson". This male may well be the type of *foveolatus*.

Distribution.—*C. foveolatus* is recorded only from the South Island where it has been collected mainly in mountainous regions.

Biology.—According to Hudson (1934) this species is probably attached to alpine beeches. No other information is available about its biology.

SPECIMENS EXAMINED

SOUTH ISLAND.—NELSON: 1 ♂, 1 ♀, Mt. Arthur, Lewis Coll. No. 193c (PDD). 1 ♂, Balloon Hut (4,300 ft), Mt. Arthur, 8.I.1930, E. S. Gourlay (EG). 1 ♂, Mt. Arthur, no date, G. V. Hudson (BMNH). 1 ♂, Mt. Arthur, no other data (BMNH). 1 ♂, 1 ♀, Mt. Arthur Tableland (3,600 ft), —.I.1891, G. V. Hudson (DM). 1 ♂, 1 ♀, Mt. Arthur Tableland (3,600 ft), —.I.1889, G. V. Hudson (DM). 1 ♀, Flora Saddle, Mt. Arthur, 13.I.1918, coll. ? (DM). 1 ♂, Nelson, no other data (PDD). 2 ♂, Nelson (3,000 ft), 1890, G. V. Hudson (BMNH). 1 ♀, Wairoa Gorge, 9.IV.1950, J. L. Gourlay (EG). 1 ♂, Upper Maitai, 12.II.1939, E. S. Gourlay (EG). WESTLAND: 1 ♂, Boatmans, no other data (BMNH). 1 ♀, Ross, no other data (DM). CANTERBURY: 1 ♀, Governors Bush, Christchurch, no date, Sharp Coll. (BMNH). OTAGO: 1 ♀, Mt. Earnslaw, 9.I.1945, E. S. Gourlay (EG). 2 ♀, Upper Routeburn River, 21.I.1925, C. E. Clarke (AM). 1 ♂, Routeburn River (at hut), 7.I.1945, C. E. Clarke (BMNH). 1 ♀, Routeburn River (at hut), 8.I.1945, C. E. Clarke (BMNH). SOUTHLAND: 1 ♀, Flat Top Mt. (3,500 ft), near Lake Manapouri, 1.I.1929, C. E. Clarke (AM). 1 ♀, Hunter Mts., —.I.1915, coll. ? (BMNH).

Ceratognathus reflexus (Broun)

Figs 83, 84, 175, 176, 198, 210

Mitophyllus reflexus Broun, 1909, *Trans. N.Z. Inst.*, 41: 148; male; original description. Type locality: Chatham Islands, approximately 460 miles east of New Zealand.

Ceratognathus reflexus (Broun), Benesh, 1960, *Coleopt. Catal.*, pt. 8 (Ed. sec.): 20.

This species resembles *irroratus* in size and general shape, but it is readily distinguished from the latter by the very narrow scales on the dorsal surface, and by the absence of black blotches on the elytra.

Body small and slender; reddish-brown in colour except for the antennae, palps and abdomen which are paler. Dorsal surface glossy, very densely and coarsely punctate, most of the punctures bearing elongate, narrow, appressed or decumbent, pale yellow scales, a few bearing setae. Ventral surface with fine, dense punctures most of which bear appressed or suberect, elongate, narrow, yellow scales or setae.

Head (Figs 83, 84) widest at the eyes; dorsal surface flattened or slightly concave on the anterior half, convex on the posterior half. There is a small, irregular elevation on the midline between or behind the eyes. Scales and setae near the eyes and along the anterior margin erect, remainder appressed. Intermandibular projection truncate and directed anteroventrally. Preocular margin very short. Labrum short, broad, setose; proximal two-thirds hoizontal; distal third vertical; distal edge angulate in the middle. Mandibles not lobed externally. Ligula not divided.

Pronotum considerably flattened dorsally; front angles blunt, obtuse and scarcely produced anteriorly; hind angles obtuse or right-angled, sharp but not prominent; sides moderately convex, widest near the middle, and irregularly serrated. Elevated, glossy, sparsely punctate areas occur as follows on the disc: there is a broad, median band on at least the posterior half of the disc, and there are four or six irregularly shaped, approximately symmetrically arranged areas on the anterior two-thirds of the disc. Scutellum with dense decumbent, pale yellow scales.

Elytral shoulders, sides, and sutural margin as in *irroratus;* traces of one to four striae are present on each elytron, and in some specimens the elytra are faintly mottled with small, irregularly shaped, pale areas which have broader scales than does the remainder of the elytron.

Mesosternum slightly to very strongly convex between and in front of the second coxae. Metasternum with a broad, shallow groove along the midline. Pro- and mesto-sterna with setae mainly. Metasternum with setae laterally, and with scales near the midline. Abdominal sternites with numerous scales and a few setae.

Legs similar to those in *irroratus,* but slightly more slender.

MALE

Length (with mandibles), 10·3 to 12·8 mm.; (without mandibles), 9·7 to 11·8 mm.: breadth, 4·1 to 4·8 mm.

Anterior margin of head rimmed in some specimens; preocular margin greatly elevated above scape base; width of eyes together one-half the width of head; intermandibular projection moderately long. Mandibles moderately deep dorsoventrally; each with a strong apical tooth directed anteromedially, a large, subapical, dorsal tooth which is approximately horizontal, and with two to four very small teeth along the medial edge. Mentum with a very large tubercle near the centre of the external surface. Antennal club with dense long setae, and about 5·8 times deeper than wide.

Pronotum approximately 1·5 times wider than head; brim very wide and strongly reflected. Fifth abdominal sternite 3·6 to 3·8 times wider than long, and with the distal edge slightly convex.

Male Genitalia (Figs 175, 176). Aedeagus (Fig. 175) symmetrical. Penis very narrow, and compressed laterally; dorsal surface smooth and convex; ventral surface strongly concave, and with a blunt, short hook distally; ostium terminal; basal orifice basal. Internal sac narrow, and about one-half the length of penis; proximal one-quarter and distal one-quarter colourless and without scales; remainder with colourless scales (Fig. 176), the three types intermingled and with their tips directed toward the proximal end of the sac. Parameres separated from basal piece dorsally, continuous with it ventrally, and articulating on the dorsal surface of the penis; distal third of paramere compressed laterally, convex dorsally and ventrally, and with seven to 13 small spines on dorsal surface. Ninth abdominal segment (Fig. 198) symmetrical.

FEMALE

Length (with mandibles), 11·6 to 12·0 mm.; (without mandibles), 10·8 to 11·1 mm.: breadth, 4·3 to 4·9 mm.

Anterior margin of head weakly rimmed; intermandibular projection short; preocular margin not greatly elevated above scape base; width of eyes together one-third to two-fifths the width of head. Mandibles concave on the dorsal surface; medial edge irregular but not toothed. External surface of mentum convex but not tuberculate. Antennal club with sparse, short setae, and about 1·2 times deeper than wide.

Pronotum approximately 2·0 times wider than head; brim narrow and not reflected. Fifth abdominal sternite about 2·8 times wider than long, and with the distal edge strongly convex.

Female Genitalia (Fig. 210). Styli 1·4 to 1·6 times longer than wide; internal angle obtuse; external angle acute; distal edge convex. Bursa copulatrix very small, tapering distally.

Type: Location unknown.

Geographic variation.—Geographic variation is not apparent in the small sample available for study.

Distribution.—This species is known only from the Chatham Islands, about 460 miles east of Christchurch, New Zealand.

Biology.—No information is available about the biology of *reflexus*. The large eyes and well developed antennal clubs of males possibly indicate that members of that sex are active fliers.

SPECIMENS EXAMINED

CHATHAM ISLANDS.—1 ♂, Chatham I., no other data (BMNH). 1 ♂, Owenga, Chatham I., —.X.1931, G. H. Gubbins (EG). 6 ♂, 1 ♀, Mangere I., 4–21.I.1924, C. Lindsay (CM). 2 ♂, 1 ♀, Pitt I., no date, T. Hall (BMNH). 2 ♂, 1♀, Pitt I., 16–26.I.1944, E. S. Gourlay (EG). 2 ♂, no data (AM).

Ceratognathus alboguttatus Bates

Figs 15, 19, 85–87, 177–180, 199, 211

Ceratognathus alboguttatus Bates, 1867, *Entom mon. Mag.*, 4: 54–55; male; original description. Type locality: Canterbury Province, New Zealand. Parry, 1870, *Trans. ent. Soc. Lond.*, p. 67.

Ceratognathus fusculus Broun, 1886, *Manual N.Z. Coleopt.*, pt. 4: 837; female; original description. Type locality: Taieri (Dunedin), New Zealand. NEW SYNONYMY.

Mitophyllus cristatellus Broun, 1917, *Bull. N.Z. Inst.*, 1: 391; male; original description. Type locality: Routeburn (north of L. Wakatipu), New Zealand. NEW SYNONYMY.

This species exhibits pronounced local variation in external morphological characters. The adults are moderately small, slender beetles in which the cuticle of the dorsal surface is uniformly black or brown, and is coarsely and more or less uniformly densely punctate; most of the punctures bear appressed to suberect brown scales. In addition, each elytron has small groups of paler, subdecumbent or suberect scales arranged in four longitudinal rows, with two to six groups in each row. In size and coloration this species shows some resemblance to *insignis, dispar* and *macrocerus* but it is immediately distinguished from these species by the shape of the head and mandibles.

Dorsal surface dull. Ventral surface glossy; with dense, coarse punctures bearing short, decumbent and appressed, pale yellow scales.

Head (Figs 85, 86) short and broad, widest at the eyes; intermandibular projection, short, emarginate distally; preocular margin truncate or emarginate and moderately elevated above scape base. Labrum narrow and moderately setose; directed anteroventrally; distal edge rounded and receding. Maxilla as in Fig. 15. Labium as in Fig. 19; mentum truncate, and moderately convex externally; ligula deeply notched distally. Antennal club with short setae.

Pronotum moderately convex dorsally, and 1·7 to 1·8 times wider than head; front angles very variable, ranging from blunt, obtuse and scarcely produced anteriorly to sharp, acute and extending well forward; hind angles obtuse, not prominent; sides moderately convex, widest near the middle, finely and unevenly to coarsely and evenly serrated, and with a narrow, horizontal brim. Most of the specimens examined have some smooth, naked areas on the disc, but the development of these areas is extremely variable and in two specimens (one from Dunedin, one from Queenstown) they are absent. The disc usually has a slightly elevated, smooth area on part or all of the midline, and two pairs of slightly depressed to slightly elevated, symmetrically arranged, smooth areas elsewhere on its surface. In addition to the brown scales on most of the surface of the pronotum, there are groups of pale yellow decumbent scales in the hind angles, on either side of the midline on the anterior and posterior margins, and in the centre of the disc. Scutellum with brown and pale yellow scales.

Elytral shoulders rounded, not prominent; sutural margin slightly raised; sides with or without serrations. Each elytron with pale, subdecumbent or suberect scales arranged in groups in four longitudinal rows. There are two to four groups in each row, and in some specimens the groups are separated by glossy, sparsely punctate areas on the cuticle.

Mesosternum slightly convex between and in front of second coxae. Midline of metasternum marked by a fine groove or ridge on either side of which the cuticle is naked.

Legs as in *irroratus* except that the vestiture is mainly setose, and that most of the setae on the third and fourth tarsomeres are marginal.

MALE

Length (with mandibles), 6·9 to 10·5 mm.; (without mandibles), 6·3 to 9·4 mm.: breadth, 3·2 to 4·2 mm.

Head with a triangular depression between and in front of eyes; anterior margin truncate or shallowly notched in the middle, and rimmed in some specimens; intermandibular projection approximately vertical; width of eyes together about one-fifth the width of head. Labrum short. Mandibles (Figs 86, 87) bidentate apically, the ventral tooth directed medially, the dorsal tooth approximately horizontal; medial edge with a long, horizontal, ventral lobe and with a variably developed, horizontal, dorsal lobe; external edge produced into a large, reflected lobe at the base. Antennal club about 1·8 times deeper than wide.

Fifth abdominal sternite 3·8 to 3·9 times wider than long; distal margin slightly convex.

Male Genitalia (Figs 177–180). Aedeagus (Fig. 177) asymmetrical, moderately broad, cylindrical; ostium terminal; basal orifice slightly dorsal. Internal sac broad, 1·4 to 2·0 times longer than penis; proximal one-tenth colourless and unarmed; remainder with dense long, narrow, sharply pointed, brown scales (Fig. 178) and with a few shorter, broader, blunter scales (Figs 179, 180). The tips of the scales are directed towards the proximal end of the internal sac.

Parameres separated from basal piece and articulating dorsally on the penis; proximal one-third concave and membranous medially; remainder cylindrical, and moderately strongly sclerotized except for the tips which are colourless and soft. The left paramere is shorter and narrower than the right paramere, and in side view is horizontal. The distal half of the right paramere curves dorsally. The right side of the basal piece is larger than the left. The degree of asymmetry of the parameres is variable; in several of the specimens examined the difference in length between the right and left parameres is greater than in the specimen illustrated. Ninth abdominal segment (Fig. 199) strongly asymmetrical.

FEMALE

Length (with mandibles), 7·2 to 9·7 mm.; (without mandibles), 6·9 to 9·1 mm.: breadth, 3·2 to 4·4 mm.

Head slightly depressed dorsally on the anterior one-third; anterior margin broadly rounded, and with a narrow rim on the middle one-third; intermandibular projection receding; width of eyes together one-fifth to one-quarter the width of head. Labrum long. External edge of mandible with a small, angulate or broadly rounded lobe at the base. Antennal club about 1·3 times wider than deep.

Fifth abdominal sternite approximately 3·0 times wider than long; distal edge strongly convex.

Female Genitalia (Fig. 211). Styli 1·0 to 2·0 times longer than wide; internal angle obtuse; external angle sharply acute; distal edge truncate. Bursa copulatrix broad and long. The length of the spermathecal duct is very variable.

Type material: Location of type of *alboguttatus* unknown; types of *fusculus* Broun and *cristatellus* Broun in the British Museum (Nat. Hist.).

Geographic variation.—Individual variation is very marked in this species, and the sample is too small for any trends in geographic variation to be very apparent. It may be significant that in the few males available from the northern part of the range the dorsal lobe on the medial edge of the mandible is narrow, almost horizontal, and considerably less than half the length of the entire mandible, whereas in males from the southern part of the range the lobe is broader, more vertical, and at least half the length of the mandible.

Distribution.—*C. alboguttatus* has been collected from the North and South Islands, mainly in alpine regions.

Biology.—No information is available about the biology of this species. In one of the males examined, the dorsal, apical tooth of both mandibles is worn down from above, suggesting tunnelling habits. Some of the specimens were found under logs.

Synonymy.—Bates' original description of the puncturation, vestiture, and mandibles of the type permits this species to be recognized without any doubt. Apparently the type specimen has brownish cuticle. The type of *fusculus* Broun has been examined by the writer; it is a female having the same coloration, puncturation and vestiture as that described for the type of *alboguttatus*. In his

description of *fusculus,* Broun omitted to mention that several groups of pale scales, characteristic of *alboguttatus,* are present on the elytra. The writer has examined the type of *cristatellus* Broun; it is a male with black cuticle, and with the groups of pale scales within the rows separated by sparsely punctate areas. Since puncturation and coloration show so much individual variation in *alboguttatus* they have very little taxonomic value, and *cristatellus* must therefore be considered conspecific with *alboguttatus.*

SPECIMENS EXAMINED

NORTH ISLAND.—TARANAKI: 1 ♂, 1 ♀, Mt. Egmont (3,000 ft), early January, 1923, G. V .Hudson (Hudson Coll., DM). WELLINGTON: 1 ♂, Mt. Alpha, Tararua Ra., 3.I.1910, coll. ? (DM).
SOUTH ISLAND.—NELSON: 1 ♂, Beeby's Knob (4,300 ft), 7.II.1937, E. S. Gourlay (EG). 1 ♀, Beeby's Knob (4,700 ft), 2.II.1929, E. S. Gourlay (EG). 1 ♂, Dun Mt. (2,000 ft), 28.XI.1943, E. S. Gourlay (EG). 1 ♂, Saddle Hill (3,000 ft), 1.II.1938, A. Richardson (EG). 1 ♂, The Doubles, 1938, A Richardson (BMNH). 1 ♀, Gordon's Pyramid, 13.I.1918, A. C. O'Connor (Hudson Coll., DM). WESTLAND: 1 ♀, Greymouth, no date, Lewis Coll. (DM). CANTERBURY: 1 ♂, Arthurs Pass, —.II.1920, Lindsay (CM). 1 ♂, Arthurs Pass, —.XII.1922, McLeay (BMNH). 1 ♀, Arthurs Pass (3,000 ft), 3.I.1923, Myers (BMNH). 1 ♂, Sealy Lake, Mt. Cook, mid-February, 1945, G. W. Gibbs (Hudson Coll., DM). 1 ♂, Port Hills, Banks Peninsula, 23.XII.1942, A. Richardson (AM). OTAGO: 1 ♂ (type of *cristatellus*), Routeburn, 10.II.1914, T. Hall (BMNH). 1 ♀, Routeburn River, 16.I.1926, coll. ? (AM). 1 ♂, Routeburn River Hut, 17.I.1926, coll. ? (AM). 4 ♂, 5 ♀, Upper Routeburn River, 25.I.1926, coll. ? (AM). 1 ♀, same locality and date, C. E. Clarke (EG). 1 ♂, 1 ♀, same locality, 17.I.1926, coll. ? (BMNH). 1 ♀, Lake Wakatipu, —.I.1921, G. V. Hudson (BMNH). 1 ♂, Kinloch, 28.XII.1913, coll. ? (AM). 1 ♂, Queenstown, 28.XII.1947, C. E. Clarke (AM). 1 ♀, Moeraki, no other data (EG). 1 ♀, same data (DM). 1 ♀, Flagstaff, Dunedin, 7.II.1916, coll. ? (AM). 1 ♀ (type of *fusculus*), Taieri, no date, S. W. Fulton (BMNH).

Ceratognathus insignis (Broun)

Figs 88, 89, 181, 182

Mitophyllus insignis Broun, 1923, *Bull. N.Z. Inst.,* 1: 687–88; male; original description. Type locality: Gordon's Pyramid, Nelson, New Zealand.

Ceratognathus insignis (Broun), Benesh, 1960, *Coleopt. Catal.,* pt. 8 (Ed. sec.): 19.

The female of this species is unknown. Males, apart from their generally larger size and strikingly different mandibles, are almost identical with those of *alboguttatus.* When additional material has been collected and studies have been

made on the biology of both species, it may be found that *insignis* is conspecific with *alboguttatus,* and that the mandibular and other differences result from allometry. The following characters distinguish males of *insignis* from those of *alboguttatus*.

Length (with mandibles), 10·5 to 13·4 mm.; (without mandibles), 9·1 to 11·2 mm.: breadth, 4·2 to 5·4 mm.

Body large, black; more glossy and with larger punctures than in *alboguttatus*. Head (Fig. 88) emarginate anteriorly; triangular depression between the eyes deeper and longer than in *alboguttatus*. Labrum very broad and short. Mandibles (Figs 88, 89) very long, narrow, arcuate laterally and bidentate apically, the dorsal tooth very long and almost vertical, ventral tooth shorter, almost horizontal, and directed medially. There is a prominent, vertical, feebly bilobed lamina on the dorsal surface immediately behind the dorsal, apical tooth. One or two small, horizontal, subapical, ventral teeth project medially. Basal half of mandible with a large, triangular lamina directed anteroventrally on the medial edge, and with a deep, dorsally reflected lobe on the outer edge.

Sides of pronotum finely and evenly serrated.

Male Genitalia (Figs 181, 182). Similar to those in *alboguttatus* except that they are larger, and that the internal sac differs in the following characters. The colourless part is about one-fifth the length of the entire sac, and the spines on the remaining part are smaller and differently arranged: the longest scales (Fig. 182) are sparse; the short, broad scales (Fig. 181) are dense in a small region adjacent to the colourless part of the sac. Ninth abdominal segment similar to that in *alboguttatus,* but larger.

Type: In the British Museum (Nat. Hist.).

Geographic variation.—This is not apparent in the small collection of specimens available for study.

Distribution.—C. insignis has been collected from alpine regions in the northern part of the South Island.

Biology.—Unknown.

SPECIMENS EXAMINED

SOUTH ISLAND.—NELSON: 1 ♂, Flora Camp (3,000 ft), Mt. Arthur, 5.I.1930, E. S. Gourlay (EG). 1 ♂, Mt. Arthur, 8.I.1918, A. C. O'Connor (DM). 1 ♂, Mt. Arthur (3,000–4,000 ft), under beech bark, 12–14.I.1918, A. C. O'Connor (PDD). 1 ♂, Mt. Arthur (4,300 ft), 16.I.1932, G. V. Hudson (Hudson Coll., DM). 1 ♂, Mt. Arthur (about 3,600 ft), 8.I.1925, G. V. Hudson (Hudson Coll., DM). 1 ♂ (Holotype), Gordon's Pyramid, no date, A. C. O'Connor (BMNH). 1 ♂, Gordons Pyramid, 13.I.1918, A. C. O'Connor (Hudson Coll., DM).

Ceratognathus cylindricus (Broun)

Frontispiece, 18
Figs 90, 183–186, 200, 213

Mitophyllus cylindricus Broun, 1895, *Ann. Mag. nat. Hist.*, (6) 15: 199; female; original description. Type locality: Wellington, New Zealand.
Ceratognathus cylindricus (Broun), Benesh, 1960, *Coleopt. Catal.*, pt. 8 (Ed. sec.): 19.

This species is easily recognized by its very small, compact, glossy, uniformly reddish-brown body which is uniformly densely punctate, the punctures bearing decumbent, strongly curved, narrow, yellow scales. External differences between males and females are very slight.

Head (Fig. 90) short and broad, widest at the eyes; surface not depressed between eyes; anterior margin truncate to slightly convex, and with a low rim; intermandibular projection not discernible; preocular margin obtusely rounded and very slightly elevated above scape base; width of eyes together one-quarter to one-third the width of head. Labrum horizontal and very broad, very setose; distal edge truncate or rounded. Mandibles small, without external lobes; each mandible with a large apical tooth directed medially, and with a small, subapical, dorsal tooth; left mandible also with a small, subapical, ventral tooth. Mentum moderately convex externally; ligula not divided. Antennal club finely pubescent and about 1·2 times wider than deep; sixth antennal segment slightly tuberculate.

Pronotum moderately convex dorsally and 1·6 to 1·9 times wider than head; front angles acute and extending forward prominently; hind angles obtuse, not prominent; sides almost straight, finely and irregularly serrated, without a brim.

Elytral shoulders rounded, not prominent; sutural margin not raised; sides not serrated.

Mesosternum slightly convex between second coxae. Posterior half of metasternum with a shallow, median groove.

Legs moderately short and stout; femora and tibiae with long, yellow setae; anterior tibia with the small teeth varying in size; middle and hind tibiae very convex externally, with the spines long and in three irregular rows; third and fourth tarsomeres of middle and hind legs uniformly setose ventrally.

MALE

Length (with mandibles), 6·3 to 8·3 mm.; (without mandibles), 6·0 to 7·8 mm.: breadth, 2·7 to 3·5 mm.

Fifth abdominal sternite truncate or slightly emarginate distally, and 4·2 to 4·5 times wider than long.

Male Genitalia (Figs 183–186). Aedeagus (Fig. 183) very slightly asymmetrical. Penis very broad, neither curved nor carinate; ostium terminal; basal orifice slightly dorsal. Internal sac broad, and about equal in length to penis; proximal

one-quarter colourless and unarmed; middle one-half with dense, dark brown scales (Figs 184–186), the long, truncate scales most numerous; distal one-quarter colourless and with a small group of dark brown scales (similar to those of the preceding region) on the ventral side. The tips of all the scales are directed towards the proximal end of the sac. Parameres slightly asymmetrical, the right shorter than the left, and articulating on the dorsal surface of the penis; completely separated from basal piece; tip of paramere compressed laterally, and curving dorsally. Left side of basal piece slightly larger than right. Ninth abdominal segment (Fig. 200) slightly asymmetrical.

FEMALE

Length (with mandibles), 8·4 to 9·3 mm.; (without mandibles), 8·0 to 8·8 mm.: breadth, 3·4 to 3·9 mm.

Fifth abdominal sternite strongly convex distally, and 3·2 to 3·5 times wider than long.

Female Genitalia (Fig. 213). Styli 1·1 to 1·9 times longer than wide; internal angle obtusely rounded; external angle very sharply acute; distal edge slightly convex. Bursa copulatrix long and narrow, and not clearly demarcated from spermathecal duct.

Type: In the British Museum (Nat. Hist.).

Geographic variation.—Not discernible in the small collection examined.

Distribution.—Although poorly represented in collections, this species appears to be widespread in the North Island. It has been collected from one locality in the South Island.

Biology.—According to Hudson (1934) larvae and adults of *cylindricus* have been found in wood that was in an advanced stage of decay. The type specimens were collected under bark of rimu (*Dacrydium cupressinum* Lamb.). The cylindrical body, spiny legs, and small mandibles in both sexes suggest that adults are wood borers.

SPECIMENS EXAMINED

NORTH ISLAND.—AUCKLAND: 1 ♀, Titirangi, 8.II.1945, M. W. Carter (PDD). 2 specs., Little Barrier I., 1913, H. Swale (BMNH). 1 ♀, Waiheke I., —.I.1944, G. Chamberlain (PDD). WELLINGTON: 1 ♂, Castlecliff, Wanganui, 10.I.1919, A. C. O'Connor (DM). 1 ♀, Levin, 8.VIII.1909, A. C. O'Connor (DM). 2 ♂, 1 ♀, Titahi Bay, 12.I.1919, A. C. O'Connor (DM). 2 ♂, Island Bay, 1908, A. C. O'Connor (DM). 2 ♂, 3 ♀, Johnstons Hill, Karori, 25.II.1942, A. Pope (DM). 2 ♀, Karori, 31.I.1928, E. Fairburn (EG). 1 ♂, 1 ♀, Karori, 31.XII.1928, E. Fairburn (PDD). 1 ♀ (Holotype), Wellington, no date, J. H. Lewis (BMNH).

SOUTH ISLAND.—CANTERBURY: 1 spec., Hooker River, Mt. Cook, —.XII.1928, S. Hudson (BMNH).

Ceratognathus dispar Sharp

Figs 91, 92, 187–190, 201, 214

Ceratognathus dispar Sharp, 1882, *Trans. ent. Soc. Lond.*, pp. 82–83; male, female; original description. Type locality: Greymouth, New Zealand.

Mitophyllus angusticeps Broun, 1895, *Ann. Mag. nat. Hist.*, (6) 15: 199–200; female; original description. Type locality: Wellington, New Zealand. NEW SYNONYMY.

Mitophyllus comognathus Broun, 1903, *Ann. Mag. nat. Hist.*, (7) 11: 616–617; male; original description. Type locality: Westport, New Zealand. NEW SYNONYMY.

Mitophyllus mandibularis Broun, 1917, *Bull. N.Z. Inst.*, 1: 390–391; male; original description. Type locality: Point Hill (3,500 ft), west of Mt. Algidus, Christchurch, New Zealand. NEW SYNONYMY.

This species comprises very small, slender, black or dark brown beetles which exhibit pronounced sexual dimorphism. The cuticle of the dorsal surface is clothed with narrow, appressed scales which are approximately evenly distributed. Most of the scales are pale yellow in colour. In size this species resembles *cylindricus, macrocerus,* and *alboguttatus,* but it is readily separated from these by the shape of the mandibles in the male and by the shape of the head in the female.

Dorsal surface dull to moderately glossy, with small to moderately large, circular punctures which are moderately to very dense and bear scales. Ventral surface glossy, with moderately dense, small punctures, those near the midline mainly bearing setae, those near the sides bearing mainly appressed, yellowish scales.

Head (Figs 91, 92) with the cuticle between the eyes horizontal; width of eyes together one-fifth to one-quarter the head width; intermandibular projection short, almost vertical. Labrum short and broad, conspicuously divided into an approximately horizontal, proximal half, and a vertical, distal half; external surface slightly setose. Mentum flattened on the external surface; ligula not divided. Antennal club finely pubescent. Many of the scales on the head are erect.

Pronotum moderately convex dorsally; front angles obtuse, not very prominent; hind angles obtuse, not prominent; sides moderately convex, widest near the middle, finely and irregularly serrated, and with a broad, horizontal brim. In some specimens a weakly elevated, smooth, median band and several irregularly shaped, smooth areas occur on the disc.

Elytral shoulders rounded, not prominent; sutural margin slightly raised; sides weakly serrated. There are no ridges or depressions on the elytra.

Mesosternum slightly convex between coxae. Metasternum with a broad, shallow, median groove.

Legs long and slender; femora and tibiae with long, appressed setae and fine scales; anterior tibia with the small teeth uniform in size; middle and hind tibiae

moderately convex externally and with a few very small spines; middle tibia often with a large spine near the middle; third and fourth tarsomeres with only marginal setae ventrally.

MALE

Length (with mandibles), 5·9 to 8·7 mm.; (without mandibles), 5·5 to 8·0 mm.: breadth, 2·4 to 3·5 mm.

Head widest at the eyes; anterior edge truncate or weakly emarginate, rimmed in some specimens; preocular margin right-angled and slightly elevated above scape base. Mandibles not deep dorsoventrally, not lobate externally; each mandible with a large, apical tooth directed medially, and with a short, vertical, subapical, dorsal tooth; left mandible with a small, subapical, ventral tooth directed inwards. There is a large amount of individual variation in the development of the teeth; in some specimens the subapical, dorsal tooth is vestigial, in others it is very prominent and bifid. Antennal club about 1·8 times deeper than wide.

Pronotum about 1·9 times wider than head. Fifth abdominal sternite emarginate distally, and 4·1 to 4·7 times wider than long.

Male Genitalia (Figs 187–190). Aedeagus (Fig. 187) slightly asymmetrical. Penis broad and cylindrical, the apex directed dorsally and to the left; ostium dorsal; basal orifice a little dorsal. Internal sac broad and about one-half the length of penis; proximal one-eighth colourless and without scales; remainder with brown scales which have their tips directed towards the proximal end of the sac and are arranged as follows. There is a short proximal region bearing a few broad, serrated spines (Fig. 188); this is followed by an extensive region which bears dense broad spines (Fig. 189); the distal region bears dense, narrow scales (Fig. 190). Parameres continuous with basal piece and articulating dorsally on the penis; tips of parameres cylindrical and twisted towards the left, the tip of the right paramere directed dorsally, that of the left horizontal. Ninth abdominal segment (Fig. 201) slightly asymmetrical.

FEMALE

Length (with mandibles), 7·5 to 8·4 mm.; (without mandibles), 7·2 to 7·9 mm.: breadth, 3·2 to 3·8 mm.

Head widest postocularly; anterior margin with one small, median and two shallow, lateral indentations, and with a low rim; preocular margin very slightly elevated and approximately truncate above scape base. External edge of mandible broadly rounded near the base. Antennal club 1·0 to 1·3 times deeper than wide.

Pronotum about 2·3 times wider than head. Fifth abdominal sternite rounded distally and 3·4 to 3·9 times wider than long.

Female Genitalia (Fig. 214). Styli 1·8 to 2·0 times longer than wide; internal angle obtusely rounded; external angle sharply acute; distal edge convex. Bursa

copulatrix short and broad. The point of entry of the spermathecal duct into the bursa copulatrix varies; in some specimens it enters near the middle of the bursa copulatrix, while in others (Fig. 214) it enters near the junction of bursa copulatrix and bursal duct.

Type: In the British Museum (Nat. Hist.); types of *comognathus* Broun and *mandibularis* Broun also in the British Museum; location of type of *angusticeps* Broun unknown.

Geographic variation.—The sample is too small and local variation too pronounced for broad patterns of geographic variation to be discernible.

Distribution.—This species is probably widespread throughout New Zealand. The writer has seen specimens from several widely separated localities in the South Island, and from the central part of the North Island. The type of *angusticeps* Broun is stated to be from Wellington.

Biology.—No information available.

Synonymy.—The writer has examined the types of *mandibularis* Broun and *comognathus* Broun and considers them to fall well within the range of variation shown by *dispar*. The allotype of *dispar* is unknown to the writer but Sharp's original description is sufficiently detailed to permit recognition of females of the species. The type of *angusticeps* Broun has not been examined by the present author, but the original description does not allow its differentiation from the female of *dispar*. It should be noted that *comognathus* Broun is incorrectly spelt *coniognathus* in the catalogues of Roon (1910), Didier and Séguy (1953), and Benesh (1960).

SPECIMENS EXAMINED

NORTH ISLAND.—TARANAKI: 1 ♀, Mt. Egmont (3,000 ft), early January, 1923, G. V. Hudson (DM). WELLINGTON: 1 ♂, Oio, 28.X.1950, C. E. Clarke (BMNH). 1 ♀, Tongariro, 16.I.1930, A. Philpott (AM). 1 ♂, Waimarino, 6.I.1930, G. V. Hudson (DM).

SOUTH ISLAND.—NELSON: 2 ♀, Nelson, no other data (BMNH). 1 ♂ (type of *comognathus*), Westport, no date, J. J. Walker (BMNH). WESTLAND: 2 ♂, 2 ♀, Waiho Gorge, 15.I.1925, coll. ? (AM). 2 ♀, Waiho Gorge, 17.I.1925, coll. ? (BMNH). 1 ♂, Waiho Gorge, —.XI.1946, M. W. Carter (PDD). 1 ♂ (type of *dispar*), Greymouth, 1881, Helms (BMNH). 1 ♂, Greymouth, no date, Helms (BMNH). 1 ♀, Otira, no date, Lewis Coll. (DM). CANTERBURY: 1 ♂ (type of *mandibularis*), Point Hill (3,500 ft), Mt. Algidus, —.XII.1913, T. Hall (BMNH). OTAGO: 1 ♀, Kinloch, 4.I.1921, G. V. Hudson (DM). 1 ♀, Kinloch, 31.XII.1920, G. V. Hudson (DM). 1 ♂, 3 ♀, Dart Valley, Kinloch, under logs, 4.I.1921, G. V. Hudson (DM). SOUTHLAND: 1 ♂, Tuatapere, no date, J. H. Lewis (DM).

Ceratognathus gibbosus Broun

Frontispiece, 17

Figs 93, 94, 191, 192, 202, 215

Ceratognathus gibbosus Broun, 1886, *Manual N.Z. Coleopt.*, pt. 4: 928; female; original description. Type locality: Parua, Whangarei, New Zealand.

Mitophyllus tuberculatus Broun, 1893, *Manual N.Z. Coleopt.*, pt. 5: 1111–1112; male; original description. Type locality: Clevedon, Auckland, New Zealand. NEW SYNONYMY.

C. gibbosus is distinct from all other New ealand species of *Ceratognathus* in having two prominent tubercles near the centre of the pronotal disc, and in having the elytral suture and shoulders very greatly elevated. Sexual dimorphism is pronounced.

Body moderately large and stout; cuticle black or reddish-brown. Dorsal surface, except for mandibles and part or all of head, rather dull. Remainder of cuticle glossy. Entire dorsal surface, except mandibles, densely punctate, the punctures large, shallow, and bearing variably sized, appressed, dark brown, pale brown, and white scales. Ventral surface with small, irregularly distributed punctures bearing appressed, pale setae and brown or white scales.

Head as in Figs 93 and 94. Labrum very short, broad, slightly setose, and horizontal except for the distal extremity which is receding. Mandibles broad at the base but not lobed. Mentum concave on the external surface; ligula divided. Sixth antennal segment tuberculate.

Pronotum strongly convex dorsally and with a pair of very squamose tubercles in the middle of the disc; front angles acute and extending well forward; hind angles sharply acute and very prominent; sides strongly convex just behind the middle, irregularly serrated, and produced into a broad, reflected brim.

Elytral shoulders prominently and sharply ridged; suture greatly raised, especially on the middle one-third; sides irregularly serrated.

Mesosternum with a large tubercle between the second coxae. Metasternum very strongly convex except for a shallow, median groove.

Legs long and slender; femora with long, brown setae and small, white and pale brown scales; tibiae with black setae and white scales; anterior tibia with the small teeth uniform in size; middle and hind tibiae slightly convex externally, and with several very small spines; middle tibia lacking a large spine near the middle; third and fourth tarsomeres of middle and hind legs uniformly setose ventrally.

MALE

Length (with mandibles), 6·6 to 10·5 mm.; (without mandibles), 6·3 to 9·5 mm.: breadth, 3·3 to 5·5 mm.

Cuticle black. Most of the scales on the dorsal surface are dark brown, narrow, and do not overlap each other. Head short and broad, widest at the eyes; dorsal surface of anterior one-third deeply depressed; anterior edge biconcave, with a large, horizontal, median projection, and without a rim; intermandibular projection short, broad, vertical, truncate distally; preocular margin approximately right-angled and prominently elevated above scape base; width of eyes together one-quarter the width of head. On the midline between the eyes there is a V-shaped area lacking vestiture. Mandibles not deep dorsoventrally; each with a large, apical tooth directed inwards, and a large, subapical, dorsal tooth directed dorsomedially; right mandible with one, left mandible with two, small, subapical, ventral teeth. Antennal club about 8·0 times deeper than wide, and with dense, long, black setae.

Pronotum 1·8 times wider than head. Scales on scutellum pale and narrow. Each elytron with four small groups of pale scales along the sutural margin; remainder of elytral scales narrow and dark brown. Fifth abdominal sternite slightly convex distally and about 4·6 times wider than long.

Male Genitalia (Figs 191, 192). Aedeagus (Fig. 191) symmetrical. Penis broad, very bulbous basally, neither carinate nor curved; ostium small, dorsal, and with a pair of very small, triangular, moderately strongly sclerotized plates on the proximal edge; basal orifice basal. Internal sac broad, about 1·2 times longer than penis; proximal one-sixth colourless and without scales; distal one-sixth with very small, colourless scales (the structure of these has not been determined because it was not possible to completely evert this part of the sac); remainder of sac with dense, long, flexible, brown spines which are straight or hooked (Fig. 192) and have their tips directed towards the proximal end of the sac. Parameres continuous with basal piece, and articulating dorsally on penis; tegmen closely applied to penis for its entire length. The tip of each paramere is produced into a strongly sclerotized beak-like structure which is dorsal to the penis. Ninth abdominal segment (Fig. 202) strongly asymmetrical.

FEMALE

Length (with mandibles), 9·2 to 10·0 mm.; (without mandibles), 8·8 to 9·5 mm.: breadth, 4·5 to 5·1 mm.

Cuticle reddish-brown. Most of the scales on the dorsal surface are white or pale brown, broad, and overlap each other. Head long and narrow, widest behind the eyes; dorsal surface of head not depressed; anterior edge protruding slightly in the middle, concave on either side, and feebly rimmed; intermandibular projection very small, receding; preocular edge emarginate and very slightly raised above scape base; width of eyes together one-fifth the width of head. Antennal club about 1·5 times deeper than wide, and with sparse, short setae. There is an irregularly shaped, glossy elevation in the centre of the head.

Pronotum approximately 2·1 times wider than head. Scales on scutellum broad and pale. Fifth abdominal sternite strongly convex distally and 2·8 times wider than long.

Female Genitalia (Fig. 215). Styli about 3·0 times longer than wide; internal angle obtusely rounded; external angle acute; distal edge convex. Bursa copulatrix large, saccate, and produced into a hard, bifurcated projection near the junction of the spermathecal duct.

Type material: Type of *gibbosus* and that of *tuberculatus* Broun in the British Museum (Nat. Hist.).

Geographic variation.—Not apparent in the small collection examined.

Distribution.—This species has been collected in the North Island only, where it appears to be widespread.

Biology.—Hudson (1934) mentions that this species has been beaten from shrubs, in hot sunshine, from December until March. No other information is available.

Synonymy.—Broun separated *tuberculatus* from *gibbosus* solely on the squamosity of the dorsal surface: in the type (a male) of *tuberculatus* the scales are narrow and isolated, whereas in the type (a female) of *gibbosus* the scales are broad and overlapping. These differences in squamosity seem to be constantly correlated with sexual differences, and *tuberculatus* must therefore be treated as a synonym of *gibbosus*.

SPECIMENS EXAMINED

NORTH ISLAND.—AUCKLAND: 1 ♀ (type of *gibbosus*), Parua, Whangarei Harbour, no date, Crisp (BMNH). 1 ♂ (type of *tuberculatus*), Clevedon, no date, G. Munroe (BMNH). TARANAKI: 1 ♂, New Plymouth, 24.III.1953, F. H. Mansell (DM). WELLINGTON: 1 ♀, Pakuratahi, Kaitoke, beaten from *Hoheria* bark, 28.XII.1901, G. V. Hudson (DM). 2 ♂, Kaitoke, beaten from dead shrubs in hot afternoon sun, 16.XII.1919, G. V. Hudson (DM). 1 ♂, Upper Hutt, 9.II.1913, A. C. O'Connor (DM). 1 ♀, Days Bay, beaten from dead tree, 19.I.1926, G. V. Hudson (DM). 1 ♂, Days Bay, 16.II.1931, G. V. Hudson (DM). 1 ♂, Korokoro, flying in hot sunshine, 2.III.1926, G. V. Hudson (DM). 1 ♀, Karori, 1884, G. V. Hudson (DM). 1 ♂, Makara Hill, Karori, 9.II.1884, G. V. Hudson (BMNH).

Ceratognathus macrocerus Broun

Figs 95, 96, 193, 203, 212

Ceratognathus macrocerus Broun, 1886, *Manual N.Z. Coleopt.*, pt. 4: 837; male; original description. Type locality: Helensville, Auckland, New Zealand.

This is a very small, slender, black species, separable from other New Zealand species by the small tubercle which is present in the middle of the anterior margin of the head. Sexual dimorphism of the head is very striking.

Body moderately glossy, and black except for the legs, antennae, palps, elytral suture and sides of the pronotum which are more brownish. Dorsal surface

moderately densely and uniformly punctate, the punctures small and circular; most of the punctures bear long, narrow, appressed, brown or yellowish scales which are easily abraded, but some bear broader, pale yellow, decumbent or suberect scales which are sparse and solitary on the head and in small, scattered groups on the pronotum and elytra. Ventral surface with dense, fine punctures which bear short, pale, decumbent or appressed setae except at the sides of the metasternum where there are a few large, pale yellow, appressed or strongly curved scales.

Head (Figs 95, 96) with a few erect scales near the anterior margin and around the eyes; anterior margin with a small, vertical, median tubercle; intermandibular projection very short, broad, and emarginate distally; width of eyes together about one-third the width of head. Labrum small, narrow, very setose; horizontal proximally, vertical distally. Mandibles of both sexes very small. Mentum slightly convex on the external surface; ligula not divided. Sixth antennal segment feebly tuberculate.

Pronotum moderately convex dorsally; front angles slightly obtuse, not prominent; hind angles almost right-angled, not prominent; sides strongly convex, widest near the middle, feebly serrated, and produced into a broad brim which is reflected slightly. There are about 12 clusters of pale yellow scales on the pronotum, those in the hind angles most prominent. Scutellum with dense, decumbent, pale yellow scales.

Elytral shoulders strongly convex; elytral suture slightly raised; sides serrated, and produced into a narrow brim on the distal half. There are about 16 small groups of pale, decumbent or suberect scales on each elytron.

Mesosternum tuberculate immediately in front of second coxae. Metasternum very convex medially.

Legs long and slender; femora and tibiae with long, pale, very narrow scales; anterior tibia with the small teeth uniform in size; middle and hind tibiae moderately convex, and with very short spines in approximately three rows; middle tibia without a large spine near the middle; third and fourth tarsomeres of middle and hind legs uniformly setose ventrally.

MALE

Length (with mandibles), 5·5 to 8·0 mm.; (without mandibles), 5·4 to 7·7 mm.: breadth, 2·6 to 3·5 mm.

Head moderately elongate, widest at the eyes, and with cuticle deeply depressed between and anterior to the eyes; intermandibular projection vertical; preocular margin obtusely angulate and greatly elevated above scape base. Mandibles with a prominent, apical tooth directed inwards, and a short, subapical, dorsal tooth directed dorsomedially; left mandible also with a small, subapical, ventral tooth. Externally, towards the base of each mandible there is a small, rounded lobe which is concave on the dorsal surface. Antennal club about 10·0 times deeper than wide, and densely clothed with very long setae.

Pronotum about 1·2 times wider than head. Fifth abdominal sternite approximately truncate distally, and about 4·8 times wider than long.

Male Genitalia (Fig. 193). Aedeagus very slightly asymmetrical. Penis moderately broad, long, neither curved nor carinate, but compressed laterally near the middle; ostium dorsal; apex of penis membranous dorsally; basal orifice basal. In the single specimen available for examination the proximal part of the internal sac is everted through the ostium, but the remainder of it is not visible through the wall of the penis. The internal sac has not been examined in detail. Parameres continuous with the basal piece, and articulating dorsally on the penis; tegmen closely applied to penis. The tips of the parameres are sclerotized, cylindrical, and not curved. Ninth abdominal segment (Fig. 203), strongly asymmetrical.

FEMALE

Length (with mandibles), 7·4 mm.; (without mandibles), 7·1 mm.: breadth, 3·3 mm.

Head long and narrow, widest behind eyes, and with a narrow, shallow depression immediately behind the anterior margin; intermandibular projection directed anteroventrally; preocular margin notched and slightly elevated above scape base. External edge of mandible broadly rounded at the base. Antennal club 1·8 times deeper than wide, and with short, sparse setae.

Pronotum 2·2 times wider than head. Fifth abdominal sternite convex distally, and 3·6 times wider than long.

Female Genitalia (Fig. 212). Styli about 3·0 times longer than wide; internal angle obtuse; external angle acute; distal edge convex. Bursa copulatrix small, bulbous, and produced into a short arm on which the spermathecal duct opens. Bursal duct very slender.

Type: In the British Museum (Nat. Hist.). Broun considered the type to be a female, probably because of its small simple mandibles, but examination of the genitalia of a specimen resembling the type has shown that the latter is a male.

Geographic variation.—Undetermined.

Distribution.—Only three specimens of *macrocerus* are present in the collections examined by the writer, and they all are from the northern part of the North Island.

Biology.—One specimen has been found in leafmould and another was collected from a rotten vine. No other information is available about the biology of this species.

SPECIMENS EXAMINED

NORTH ISLAND.—AUCKLAND: 1 ♂, Unuwhao (900 ft), near Spirits Bay, in leafmould, 30.XII.1947, N. Gardner (PDD). 1 ♀, Waimatenui, in rotten vine, 15.III.1947, C. E. Clarke (AM). 1 ♂ (Holotype), Helensville, no date, T. Broun (BMNH).

ACKNOWLEDGEMENTS

The writer is greatly indebted to the following persons for the loan of material:

Mr E. B. Britton, British Museum (Nat. Hist.), London; Dr P. J. Darlington, Museum of Comparative Zoology at Harvard College, Massachusetts; Dr R. K. Dell, Dominion Museum, Wellington; Dr R. R. Forster, Otago Museum, Dunedin (formerly of Canterbury Museum, Christchurch); Mr E. S. Gourlay, Cawthron Institute, Nelson; Mr R. G. Ordish, Dominion Museum, Wellington; Drs A. M. Richards and D. Spiller, Plant Diseases Division, D.S.I.R., Auckland; Mr E. G. Turbott, Canterbury Museum, Christchurch (formerly of Auckland Institute and Museum).

Most of the research for this revision was carried out at the Harvard Biological Laboratories as part of the thesis requirements for the degree of Doctor of Philosophy in Biology at Radcliffe College, Massachusetts. The work was expanded and put into its present form at the Dominion Museum, Wellington. The author has much pleasure in acknowledging the very helpful suggestions and continued interest of Professors F. M. Carpenter, E. O. Wilson, Drs P. J. Darlington and E. A. Chapin, all of Harvard University, and of Dr W. L. Brown, Cornell University, New York.

Part of the research was financed by a fellowship from the International Federation of University Women; a Sigma Xi-RESA Research Grant enabled the writer to examine Broun types and other material at the British Museum (Nat. Hist.).

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ILLUSTRATIONS

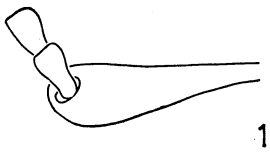
FIGS 1–3.—Third, second and part of first antennal segments, showing different types of geniculation. (1) *Dorcus helmsi* (geniculate); (2) *Ceratognathus parrianus* (non-geniculate); (3) *Dendroblax earlii* (partially geniculate).

FIGS 4 and 5.—Antennal club measurements.

FIG. 6.—Pronotal terminology.

FIGS 7–9.—Part of prosternum and left foreleg, showing procoxal and prosternal processes. (7) *Dorcus helmsi;* (8) *Dendroblax earlii;* (9) *Ceratognathus parrianus.*

FIG. 10.—Terms used to describe the angle of inclination of vestiture with regard to the integumental surface. Abbreviations: C, procoxa; CP, procoxal process; D, depth; F, femur; FA, front angle; HA, hind angle; L, length; S, prosternum; SP, prosternal process; T, trochanter; W, width. In Fig. 5, $W_1 + W_2 + W_3 = W$.



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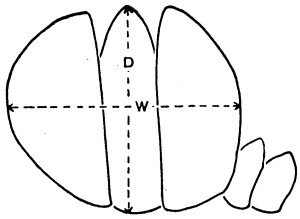

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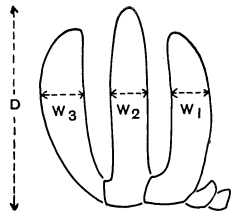

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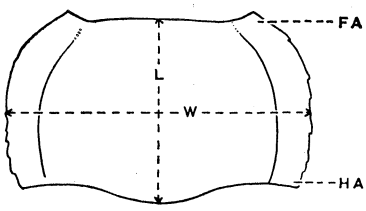

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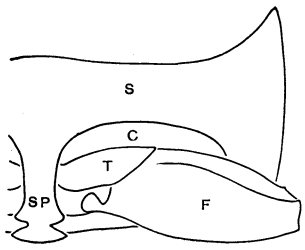

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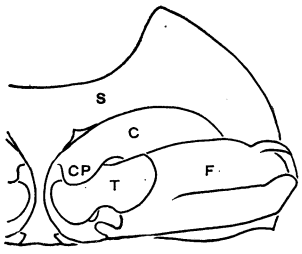

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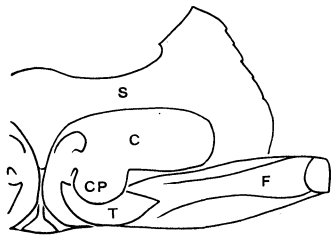

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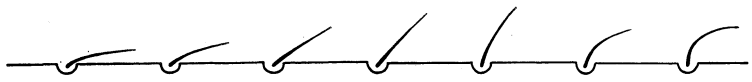

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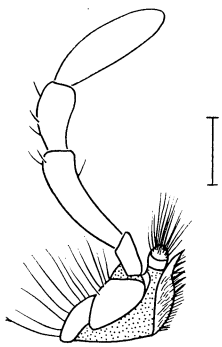

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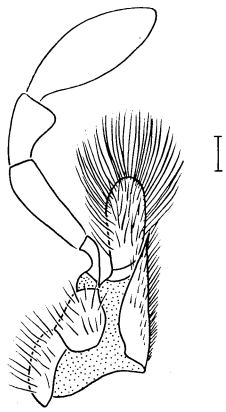

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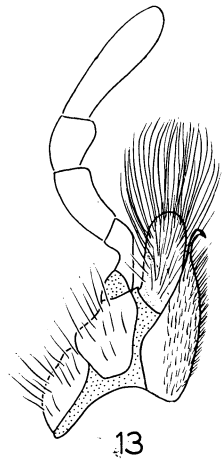

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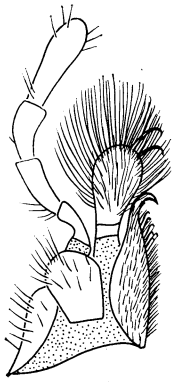

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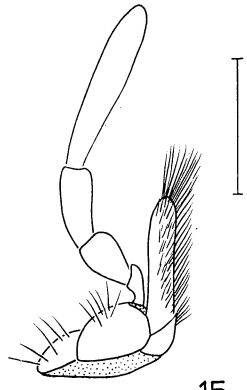

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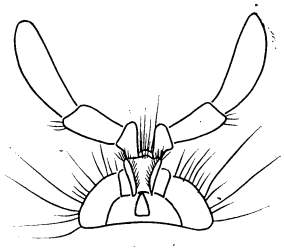

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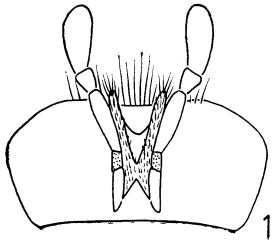

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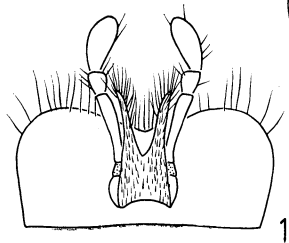

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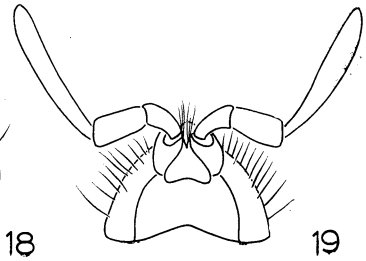

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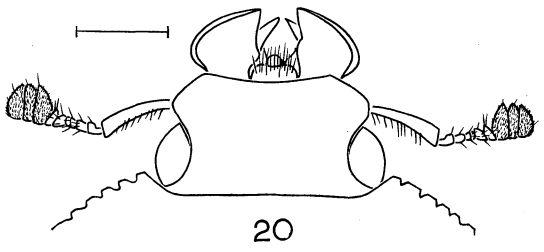
FIGS 20 and 21.—*Dendroblax earlii* (Karioi specimen). (20) head and part of pronotum of female; (21) left mandible of female.

FIGS 22 and 23.—*Dorcus novaezealandiae* (Days Bay specimens). (22) head and part of pronotum of male; (23) head and part of pronotum of female.

FIGS 24–31.—*Dorcus helmsi*. (24) head and part of pronotum of male (Stewart I.); (25) and (26) left mandible and part of head (dorsal) of males from Karamea; (27) left mandible and part of head (dorsal) of male (Mt. Greenland); (28) head and part of pronotum of female (Stewart I.); (29) part of antenna of male (Longwood Range); (30) left anterior tibia of male (Mt. Greenland); (31) left anterior tibia of female (Leslie Clearing). (All scales equal to 2.0 mm. Figures 20, 22, 23 drawn to same scale; Figs 24–28, 30, 31 drawn to same scale.)



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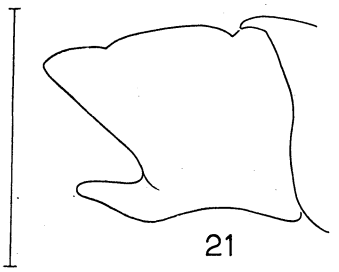

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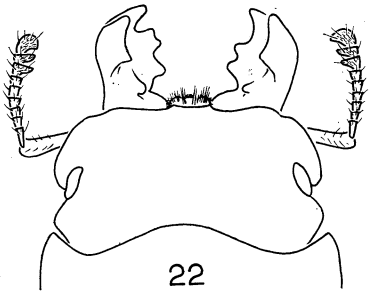

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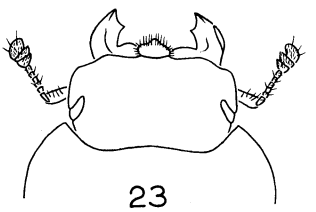

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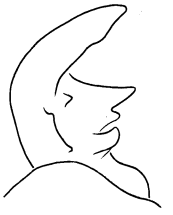

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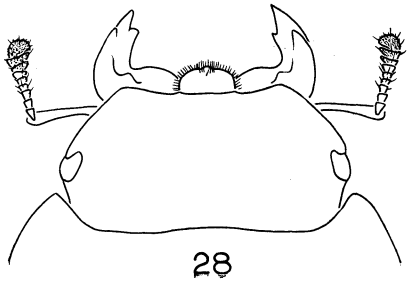

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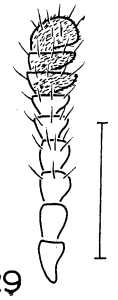

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FIGS 32–36.—*Dorcus philpotti* (Hump Mt. specimens). (32) head and part of pronotum of male; (33) head and part of pronotum of female; (34) part of antenna of male; (35) left anterior tibia of male; (36) left anterior tibia of female.

FIGS 37–40.—*Dorcus ithaginis* (Mokohinau Is. specimens). (37) head and part of pronotum of male; (38) head and part of pronotum of female; (39) part of antenna of male; (40) left anterior tibia of male. (All scales equal to 2.0 mm. Figures 32, 33, 35–38 drawn to same scale; Figs 34, 39, 40 drawn to same scale.)

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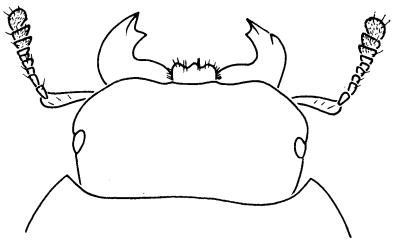

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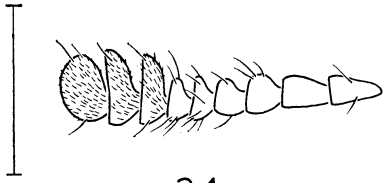

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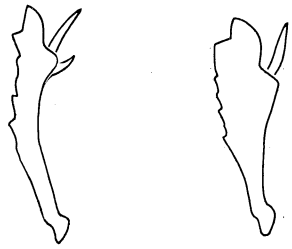

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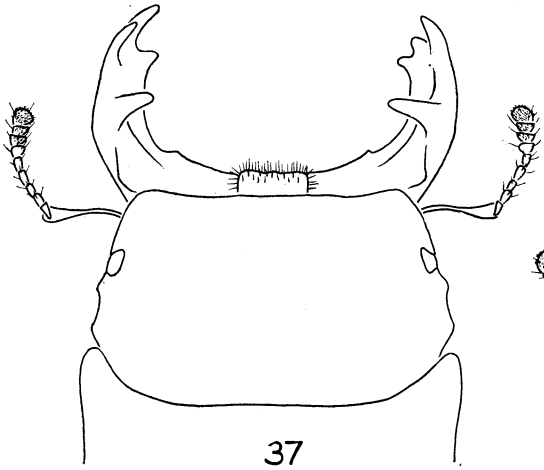

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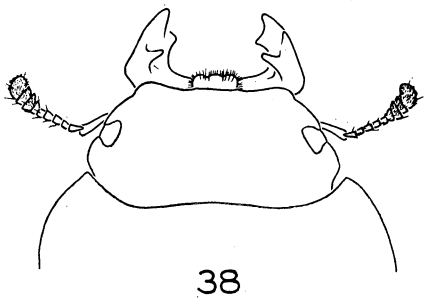

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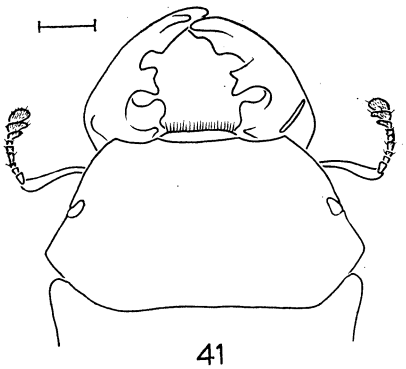
FIGS 41–43.—*Dorcus auriculatus*. (41) head and part of pronotum of holotype male; (42) head and part of pronotum of female (Waikato); (43) left anterior tibia of holotype male.

FIGS 44–48.—*Dorcus capito*. (44) head and part of pronotum of male (Sisters I.); (45) head and part of pronotum of female (Sisters I.); (46) head and part of pronotum of male (Mangere I.); (47) head and part of pronotum of female (Chatham I.); (48) left mandible (lateral) and part of head of male in Fig. 44. (All scales equal to 2.0 mm. Figures 42, 43 drawn to same scale; Figs 44–48 drawn to same scale.)



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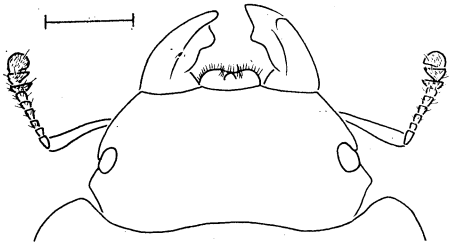

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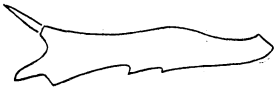

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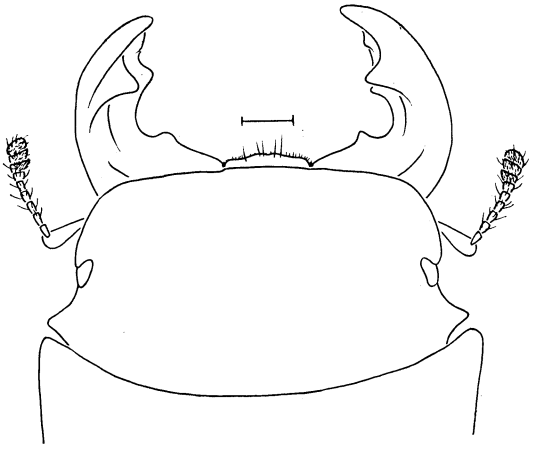

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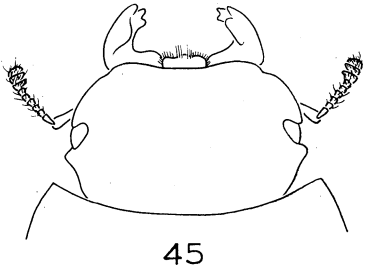

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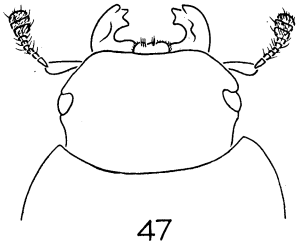

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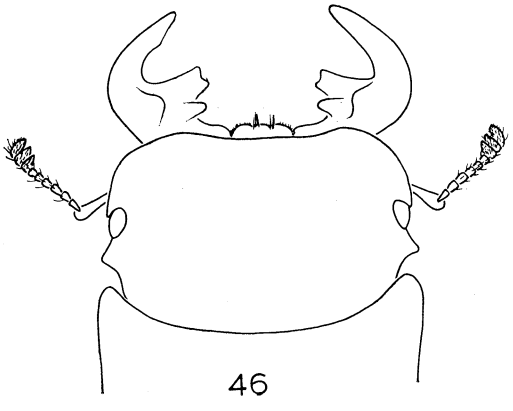

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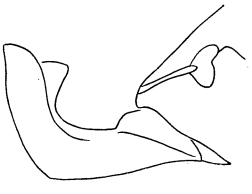

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FIGS 49 and 50.—*Lissotes reticulatus*. (49) head and part of pronotum of female (Heretaunga); (50) left elytron of male (Days Bay).

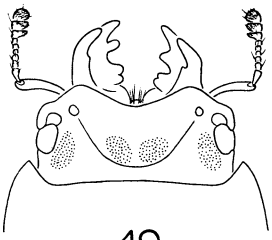
FIGS 51 and 52.—*Lissotes rufipes* (Mt. Arthur specimens). (51) head and part of pronotum of female; (52) left elytron of male.

FIGS 53–56.—*Lissotes planus* (Waimatenui specimens). (53) head and part of pronotum of male; (54) head and part of pronotum of female; (55) left elytron of male; (56) left anterior tibia of male.

FIGS 57–59.—*Lissotes stewarti*. (57) head and part of pronotum of male (Rangitikei River); (58) head and anterior part of pronotum of female (Kara); (59) left anterior tibia of male (Kare Kare).

FIGS 60–62.—*Lissotes mangonuiensis* (type specimens). (60) head and part of pronotum of male; (61) head and part of pronotum of female; (62) left anterior tibia of male.

FIGS 63 and 64.—*Lissotes oconnori* (paratype male). (63) head and part of pronotum; (64) left anterior tibia. (All scales equal to 2.0 mm. Figures 49–55 drawn to same scale; Figs 56–58 drawn to same scale; Figs 59–64 drawn to same scale. Stippling in Figs 49–52, 55 indicates coarsely punctate areas.)



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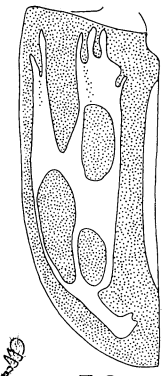

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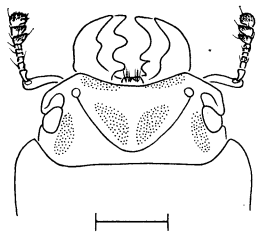

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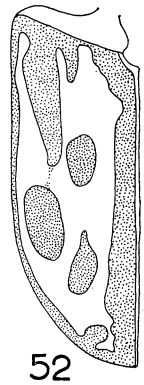

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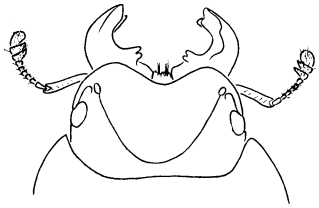

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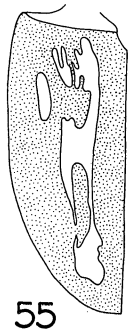

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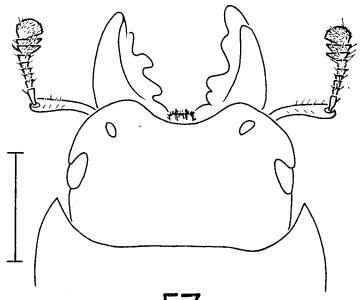

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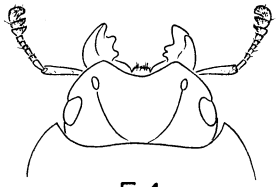

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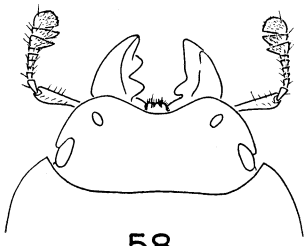

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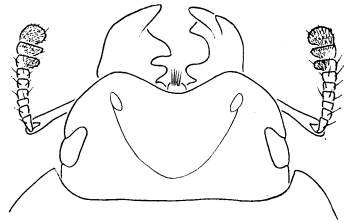

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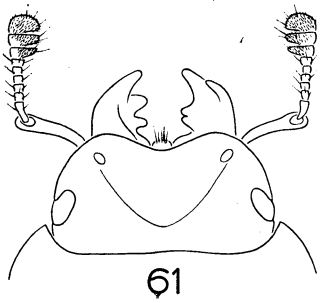

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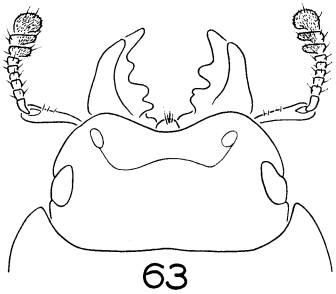

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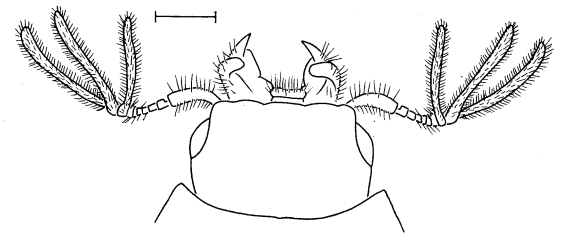
FIGS 65–67.—*Ceratognathus helotoides* (Tokaanu specimens.) (65) head and part of pronotum of male; (66) head and part of pronotum of female; (67) right anterior tibia of male.

FIGS 68–73.—*Ceratognathus irroratus*. (68) head and part of pronotum of male (Wellington); (69) head and part of pronotum of male (Auckland); (70) head and part of pronotum of female (Titahi Bay); (71) right anterior tibia of male (Titahi Bay); (72) left mandible and part of head (lateral) of male (Wellington); (73) left mandible and part of head (lateral) of male (Little Barrier I.).

FIGS 74–79.—*Ceratognathus parrianus*. (74) head and part of pronotum of male (Paekakariki); (75) head and part of pronotum of female (Wadestown); (76) left mandible (lateral) and part of head of male (Paekakariki); (77) left mandible (dorsal) of male (Wairoa Gorge); (78) left mandible (dorsal) of male (Western Hills, Whangarei); (79) left mandible (dorsal) of male (Upper Hutt). (All scales equal to 1.0 mm. Figures 65, 66, 68–70, 74, 75, 77–79 drawn to same scale; Figs 67, 71–73 drawn to same scale.)



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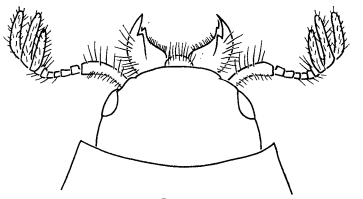

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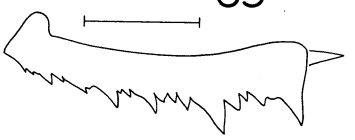

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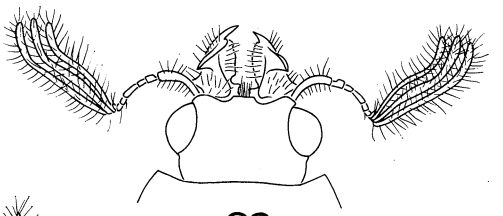

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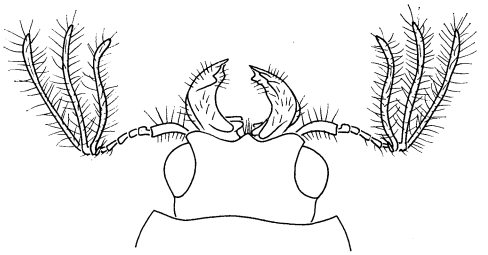

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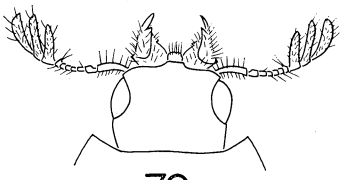

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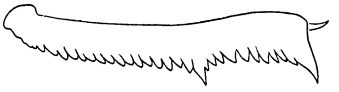

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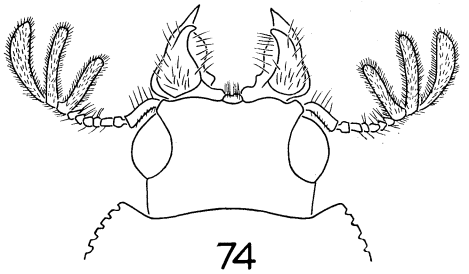

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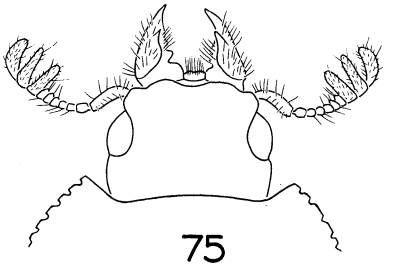

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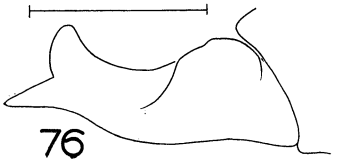

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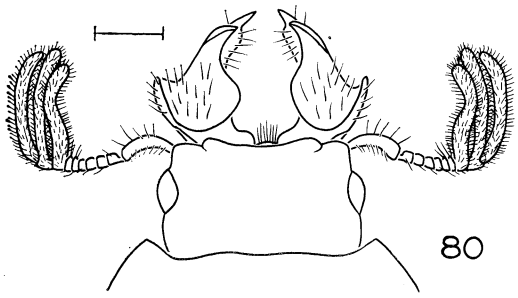
FIGS 80–82.—*Ceratognathus foveolatus*. (80) head and part of pronotum of male (Upper Maitai); (81) head and part of pronotum of female (Routeburn); (82) left mandible (dorsal) of male (Mt. Arthur).

FIGS 83 and 84.—*Ceratognathus reflexus* (Pitt I. specimens). (83) head and part of pronotum of male; (84) head and part of pronotum of female.

FIGS 85–87.—*Ceratognathus alboguttatus* (Routeburn specimens). (85) head and part of pronotum of male; (86) head and part of pronotum of female; (87) left mandible (lateral) of male.

FIGS 88 and 89.—*Ceratognathus insignis* (Mt. Arthur specimen). (88) head and part of pronotum of male; (89) left mandible (lateral) of male. (All scales equal to 1.0 mm. Figures 80–86, 88 drawn to same scale; Figs 87, 89 drawn to same scale.)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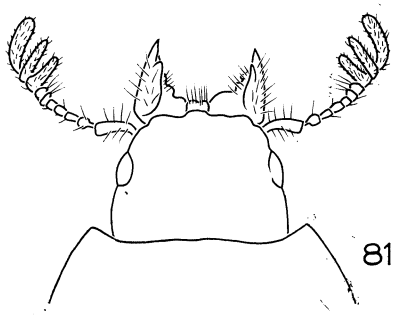
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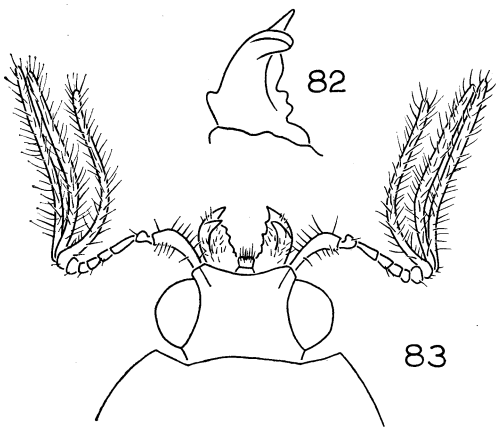
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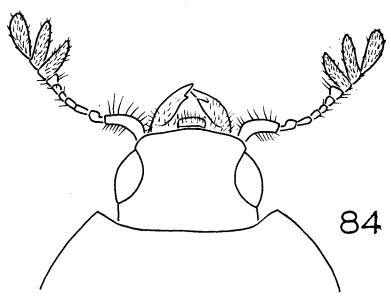
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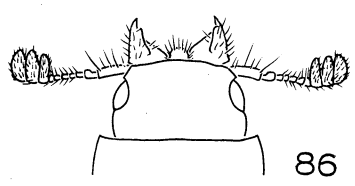
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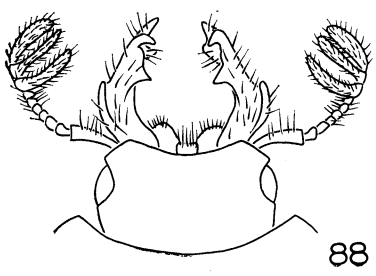
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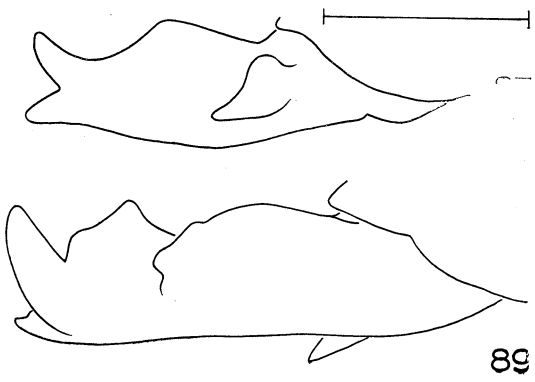
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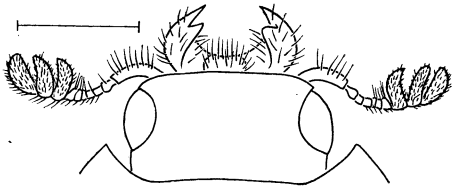
FIG. 90.—*Ceratognathus cylindricus*. Head and part of pronotum of male (Titahi Bay).

FIGS 91 and 92.—*Ceratognathus dispar*. (91) head and part of pronotum of male (Kinloch); (92) head and part of pronotum of female (Waiho Gorge).

FIGS 93 and 94.—*Ceratognathus gibbosus*. (93) head and part of pronotum of female (Karori); (94) head and part of pronotum of male (Upper Hutt).

FIGS 95 and 96.—*Ceratognathus macrocerus*. (95) head and part of pronotum of holotype male; (96) head and part of pronotum of female (Waimatenuni). (All scales equal to 1.0 mm. Figures 90–92, 96 drawn to same scale; Figs 93, 94 drawn to same scale.)



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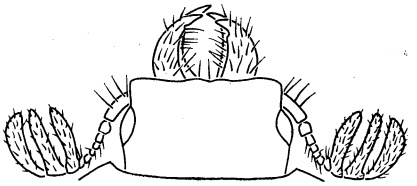

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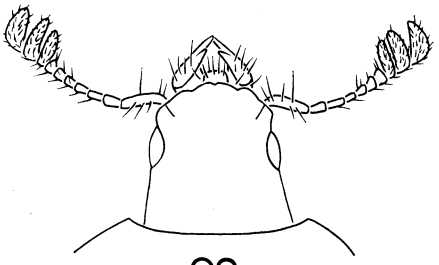

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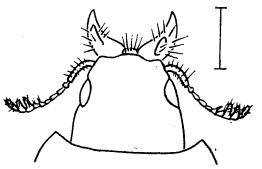

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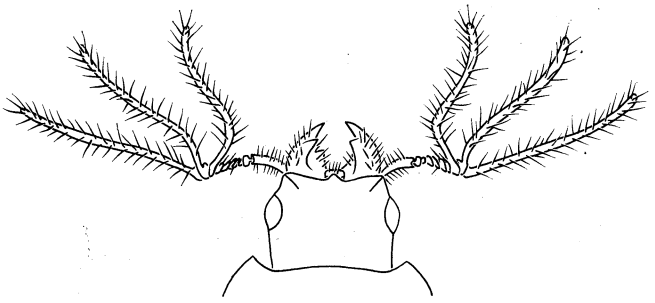

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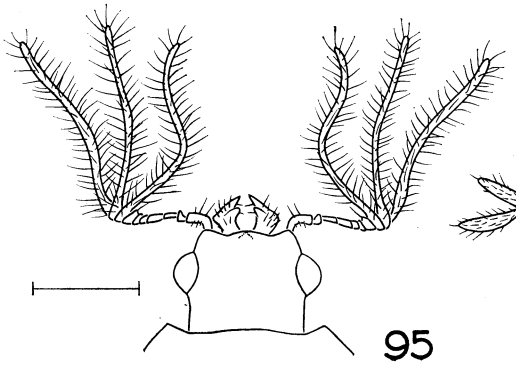

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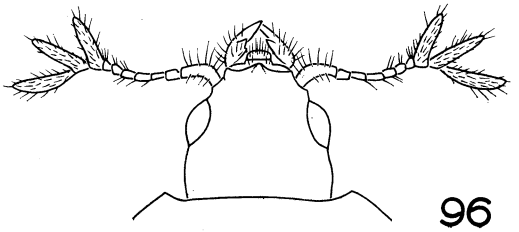
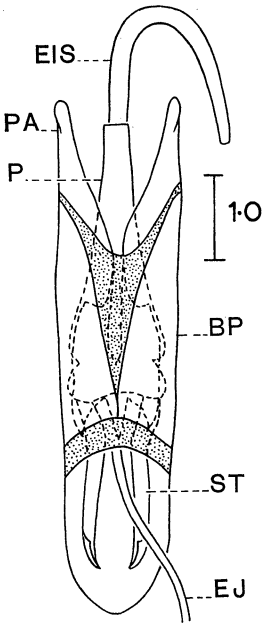


96

FIGS 97–103.—*Dendroblax earlii*. (97) aedeagus (dorsal) with internal sac partially everted (Levin); (98) penis (lateral) with internal sac pulled back through basal orifice (Levin); (99)–(101) scales on internal sac; (102) ninth abdominal segment (dorsal) of male (Levin); (103) sclerotized parts (ventral) of female genitalia (Nelson). (Scales in mm. Figures 97, 98, 102, 103 drawn to same scale; Figs 99–101 drawn to same scale.) Abbreviations: a–h, regions of internal sac (see text); AG, accessory gland; BP, basal piece; EIS, everted internal sac; EJ, ejaculatory duct; IS, internal sac; MO, median oviduct; O, ostium; P, penis; PA, paramere; S, spermatheca; SC, sclerite; SD, spermathecal duct; SG, spermathecal gland; ST, strut.



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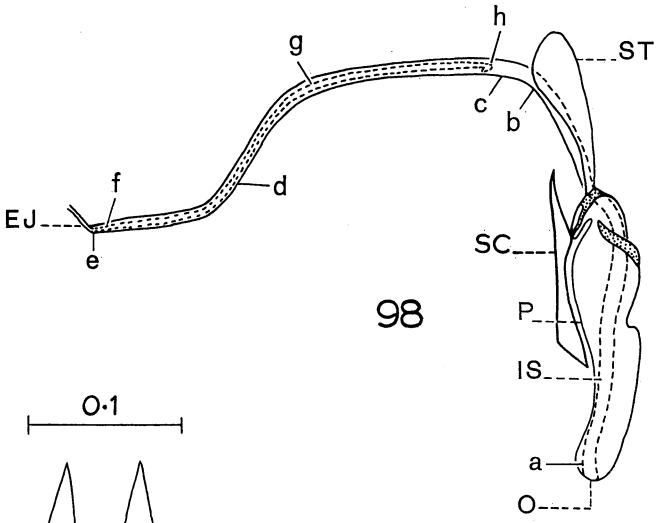

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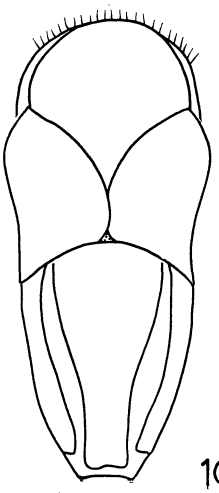

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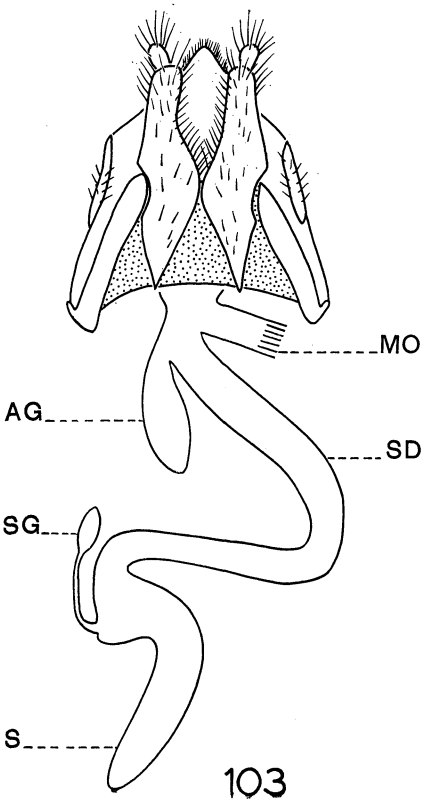
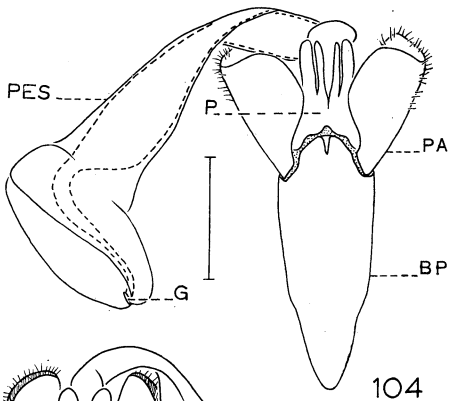


103

FIGS 104–108.—Aedeagi (ventral) of New Zealand species of *Dorcus*. (104) *D. novaezealandiae* (Days Bay); (105) *D. helmsi* (Mt. Greenland); (106) *D. philpotti* (Hump Mt.); (107) *D. ithaginis* (Mokohinau Is.); (108) *D. capito* (Southeast I.).

FIGS 109–113.—Ninth abdominal segments (dorsal) of males of New Zealand species of *Dorcus*. (109) *D. novaezealandiae* (Days Bay); (110) *D. helmsi* (Mt. Greenland); (111) *D. ithaginis* (Mokohinau Is.); (112) *D. philpotti* (Hump Mt.); (113) *D. capito* (Southeast I.). (Scales equal to 1.0 mm. Figures 104, 109 drawn to same scale; Figs 105–108, 110–113 drawn to same scale.) Abbreviations: BP, basal piece; G, gonopore; P, penis; PA, paramere; PES, permanently everted internal sac.



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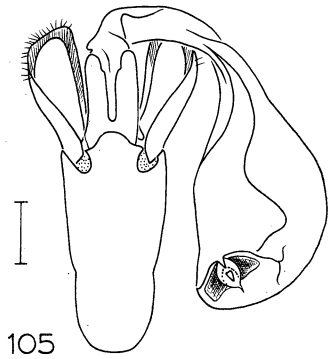

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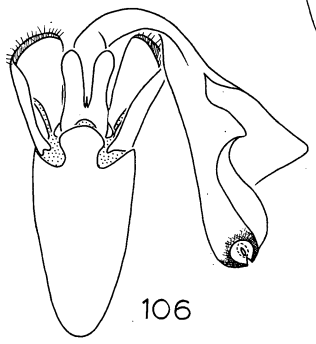

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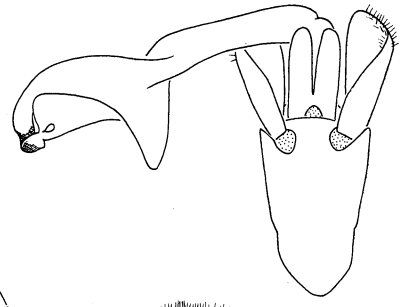

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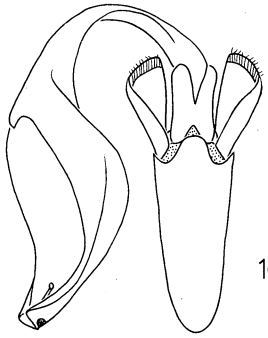

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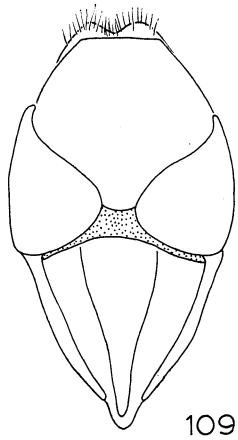

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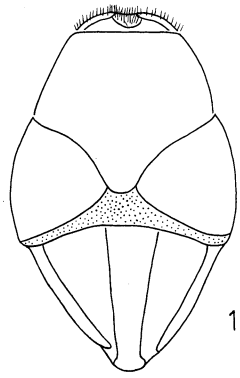

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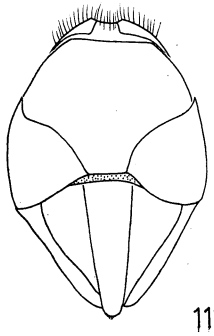

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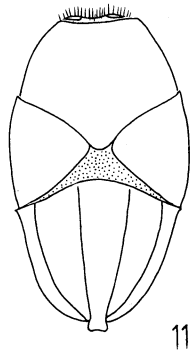
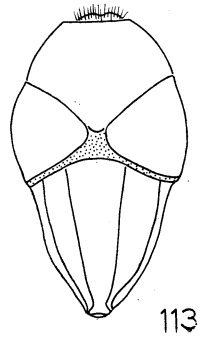


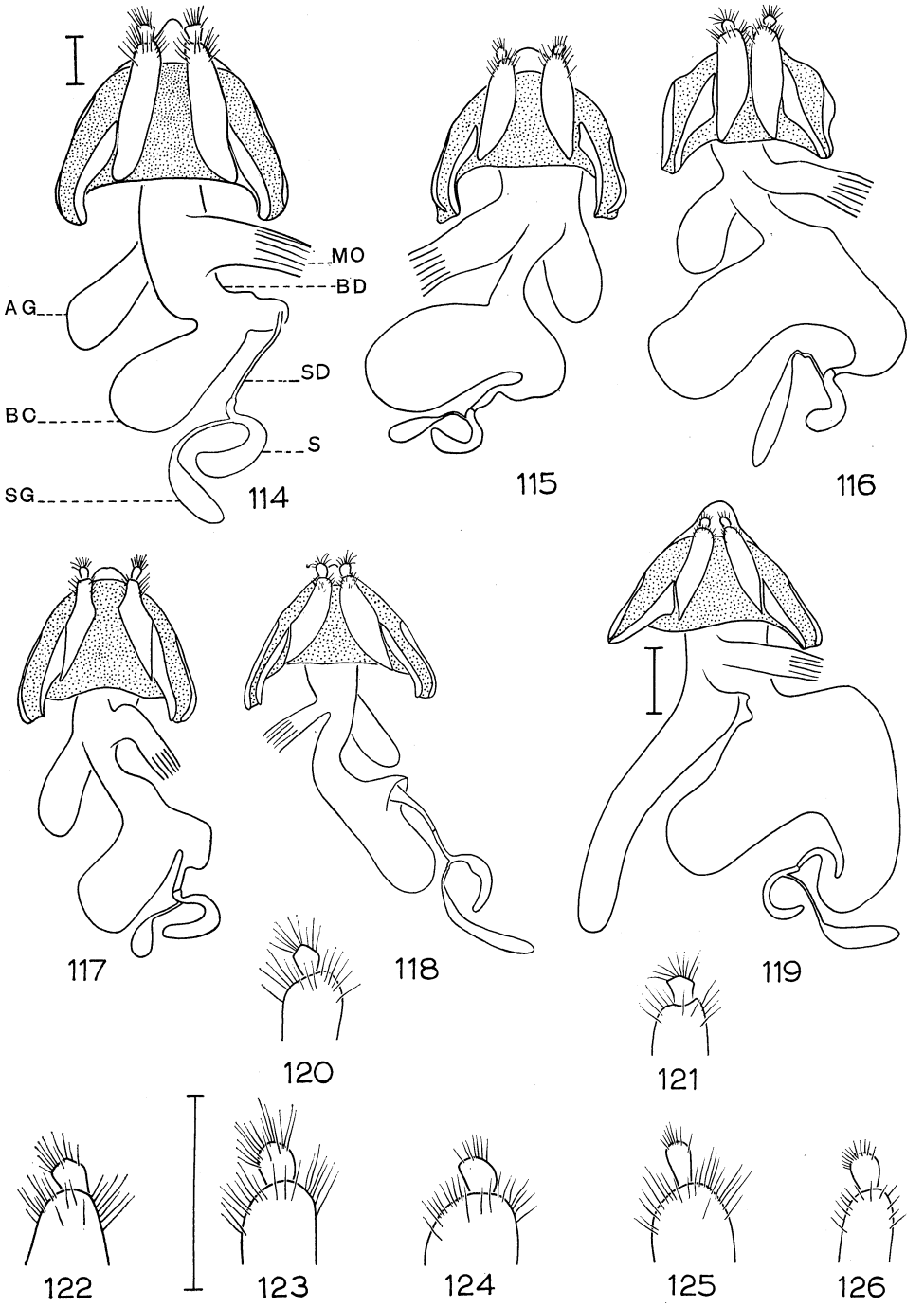
112



113

FIGS 114–119.—Sclerotized parts of female genitalia (ventral) of New Zealand species of *Dorcus*. (114) *D. novaezealandiae* (Days Bay); (115) *D. philpotti* (Hump Mt.); (116) *D. helmsi* (Karamea); (117) *D. ithaginis* (Mokohinau Is.); (118) *D. auriculatus* (Waikato); (119) *D. capito* (Chatham I.).

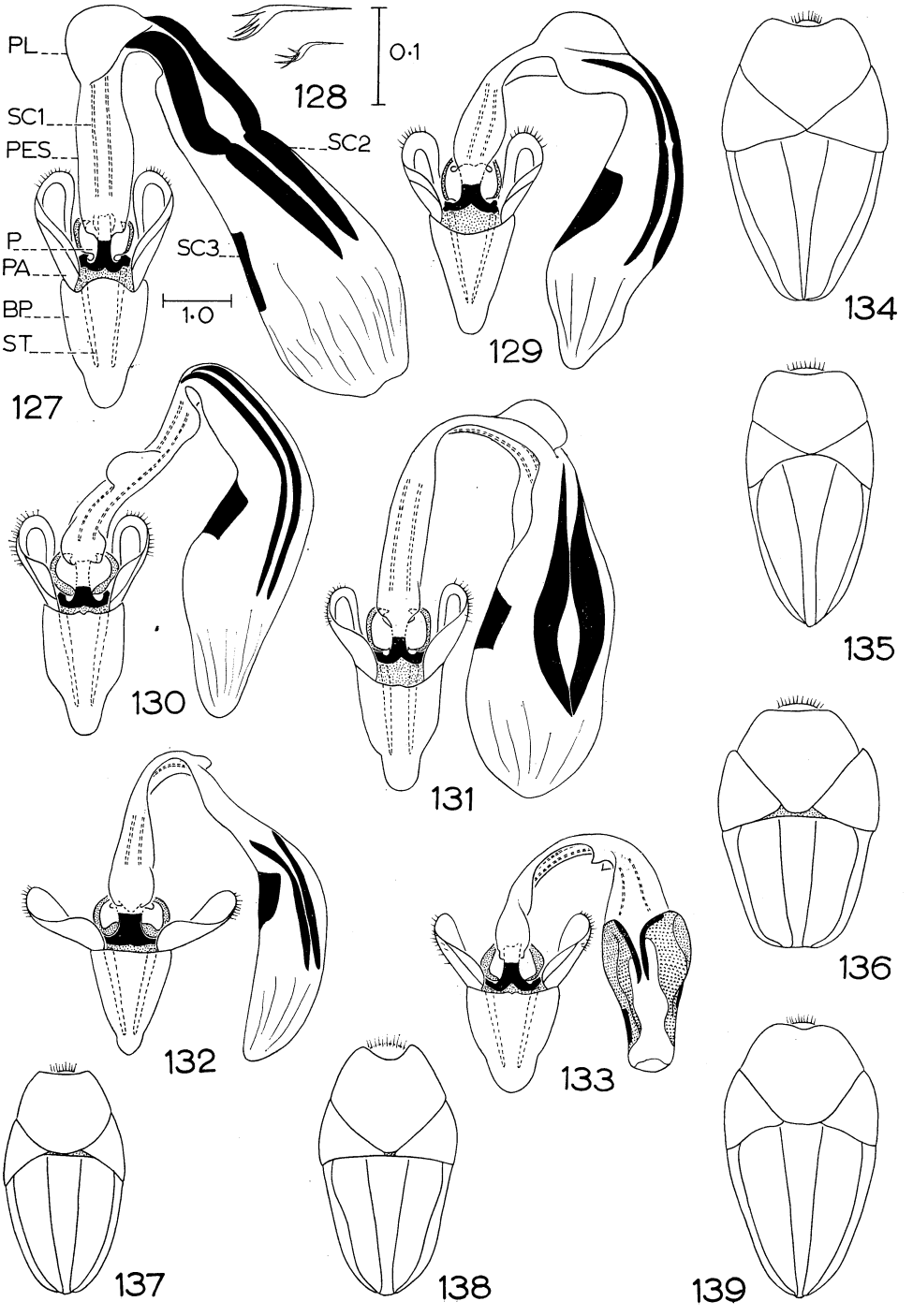
FIGS 120–126.—Left styli of female genitalia of New Zealand species of *Dorcus*. (120) *D. novaezealandiae* (Happy Valley); (121) *D. novaezealandiae* (Days Bay); (122) *D. helmsi* (Karamea); (123) *D. helmsi* (Leslie Clearing); (124) *D. philpotti* (Tewaewae Bay); (125) *D. philpotti* (Lake Hauroko); (126) *D. capito* (Chatham I.). (All scales equal to 1.0 mm. Figures 115–119 drawn to same scale; Figs 120–126 drawn to same scale.) Abbreviations: AG, accessory gland; BC, bursa copulatrix; BD, bursal duct; MO, median oviduct; S, spermatheca; SD, spermathecal duct; SG, spermathecal gland.


MO
BD
AG
SD
BC
S
SG
114
115
116
117
118
119
120
121
122
123
124
125
126

FIGS 127, 129–133.—Aedeagi (dorsal) of New Zealand species of *Lissotes*. (127) *L. reticulatus* (Khandallah); (129) *L. rufipes* (Pelorus Sound); (130) *L. planus* (Waipoua Forest); (131) *L. stewarti* (Kara Forest); (132) *L. mangonuiensis* (holotype); (133) *L. oconnori* (paratype).

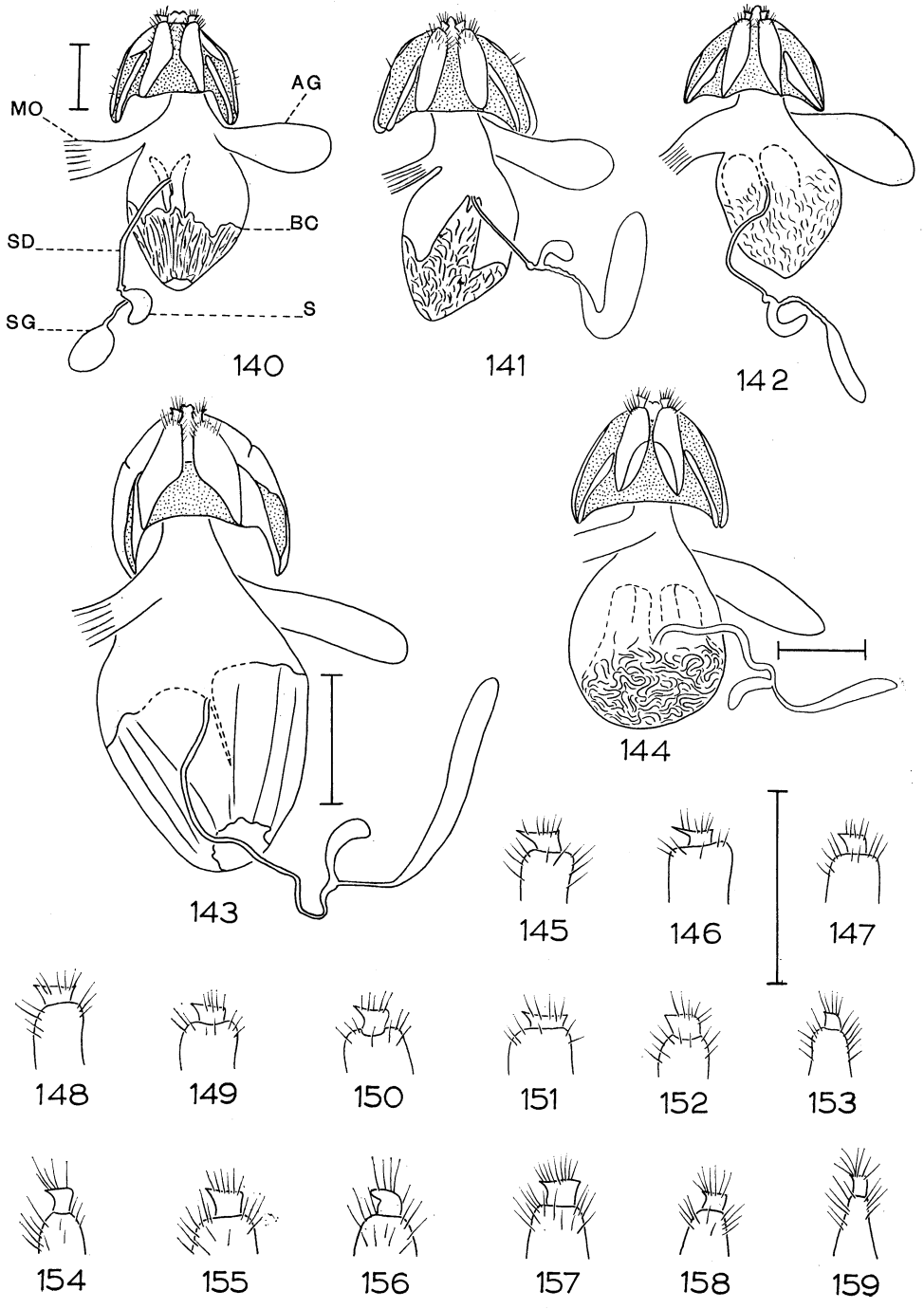
FIG. 128.—Spines from permanently everted internal sac of *L. reticulatus*.

FIGS 134–139.—Ninth abdominal segments (dorsal) of males of New Zealand species of *Lissotes*. (134) *L. reticulatus* (Khandallah); (135) *L. rufipes* (Pelorus Sound); (136) *L. planus* (Waipoua Forest); (137) *L. mangonuiensis* (holotype); (138) *L. oconnori* (paratype); (139) *L. stewarti* (Kara Forest). (Scales in mm. Figures 127, 129–139 drawn to same scale.) Abbreviations: BP, basal piece; P, penis; PA, paramere; PES, permanently everted internal sac; PL, papilla; SC1, SC2, SC3, sclerites; ST, strut.


PL
SC1
PES
P
PA
BP
ST
SC2
SC3
1·0
0·1
127
128
129
130
131
132
133
134
135
136
137
138
139

FIGS 140–144.—Sclerotized parts of female genitalia (ventral) of New Zealand species of *Lissotes*. (140) *L. reticulatus* (Days Bay); (141) *L. rufipes* (Maitai); (142) *L. planus* (Tauraroa); (143) *L. stewarti* (Whangarei); (144) *L. mangonuiensis* (allotype).

FIGS 145–159.—Left styli of female genitalia of New Zealand species of *Lissotes*. (145)—(153) *L. reticulatus* from various localities—(145) Days Bay; (146) Akatarawa; (147) Titahi Bay; (148) Heretaunga; (149) Cass; (150) Cass; (151) Mt. Algidus; (152) Otarama; (153) Mt. Grey. (154) *L. rufipes* (Maitai); (155) *L. rufipes* (Takaka); (156) *L. rufipes* (Mt. Arthur); (157) *L. planus* (Tauraroa); (158) and (159) *L. stewarti* (Whangarei). (All scales equal to 1.0 mm. Figures 140–142 drawn to same scale; Figs 145–159 drawn to same scale.) Abbreviations: AG, accessory gland; BC, bursa copulatrix; MO, median oviduct; S, spermatheca; SD, spermathecal duct; SG, spermathecal gland.


MO
AG
SD
BC
SG
S
140
141
142
143
144
145
146
147
148
149
150
151
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153
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155
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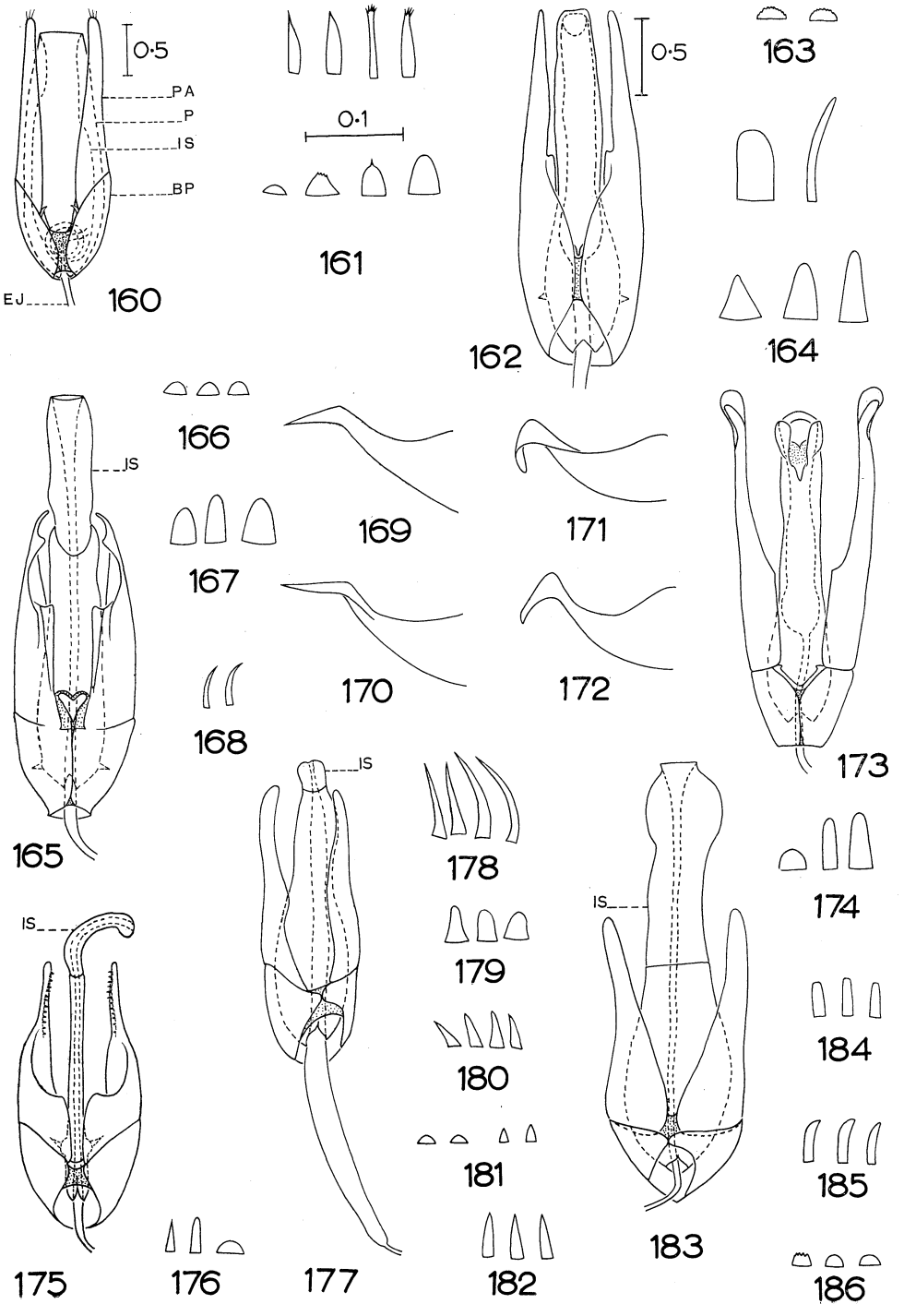
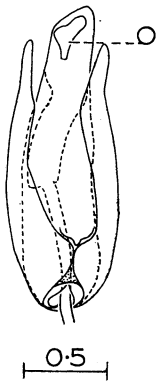
FIGS 160–186.—Parts of male genitalia of New Zealand species of *Ceratognathus*. (160) aedeagus (dorsal)of *C. helotoides* (Tokaanu); (161) scales from internal sac of *C. helotoides;* (162) aedeagus (dorsal) of *C. irroratus* (Titahi Bay); (163) and (164) scales from internal sac of *C. irroratus;* (165) aedeagus (dorsal) of *C. parrianus* (Wadestown); (166)–(168) scales from internal sac of *C. parrianus;* (169)–(172) distal end of right parameres of specimens of *C. parrianus* from various localities—(169) Titirangi; (170) Wairoa Gorge; (171) Mt. Holdsworth; (172) Waitakere Ra. (173) aedeagus (dorsal) of *C. foveolatus* (Mt. Arthur); (174) scales from internal sac of *C. foveolatus;* (175) aedeagus (dorsal) of *C. reflexus* (Pitt I.); (176) scales from internal sac of *C. reflexus;* (177) aedeagus (dorsal) of *C. alboguttatus* (Kinloch) with internal sac drawn back through basal orifice; (178)–(180) scales from internal sac of *C. alboguttatus;* (181) and (182) scales from internal sac of *C. insignis;* (183) aedeagus (dorsal) of *C. cylindricus* (Titahi Bay); (184)–(186) scales from internal sac of *C. cylindricus*. (Scales in mm. Figures 160, 165, 173, 175 drawn to same scale; Figs 161, 163, 164, 166–168, 174, 176, 178–182, 184–186 drawn to same scale; Figs 162, 169–172, 177, 183 drawn to same scale.) Abbreviations: BP, basal piece; EJ, ejacualtory duct; IS, internal sac; P, penis; PA, paramere.

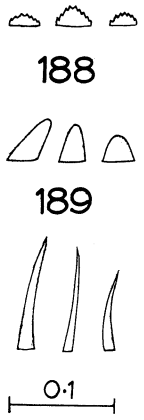

0·5
PA
P
IS
BP
EJ
160
0·1
161
0·5
162
163
164
166
167
168
169
170
171
172
IS
165
IS
173
174
IS
175
176
IS
177
178
179
180
181
182
IS
183
184
185
186

FIGS 187–193.—Parts of male genitalia of New Zealand species of *Ceratognathus*. (187) aedeagus (dorsal) of *C. dispar* (Waiho Gorge); (188)–(190) scales from internal sac of *C. dispar;* (191) aedeagus (dorsal) of *C. gibbosus* (Upper Hutt); (192) scales from internal sac of *C. gibbosus;* (193) aedeagus (dorsal) of *C. macrocerus* (Unuwhao).

FIGS 194–203.—Ninth abdominal segments (dorsal) of males of New Zealand species of *Ceratognathus*. (194) *C. helotoides* (Tokaanu); (195) *C. irroratus* (Titahi Bay); (196) *C. parrianus* (Wadestown); (197) *C. foveolatus* (Mt. Arthur); (198) *C. reflexus* (Pitt I.); (199) *C. alboguttatus* (Kinloch); (200) *C. cylindricus* (Titahi Bay); (201) *C. dispar* (Waiho Gorge); (202) *C. gibbosus* (Upper Hutt); (203) *C. macrocerus* (Unuwhao). (Scales in mm. Figures 187, 191, 195, 199–202 drawn to same scale; Figs 188–190, 192 drawn to same scale; Figs 193, 203 drawn to same scale; Figs 194, 196–198 drawn to same scale.) Abbreviations: IS, internal sac; O, ostium.



187



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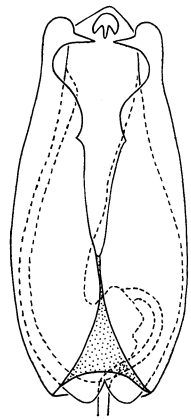

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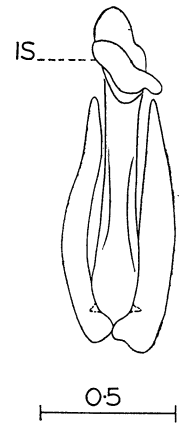
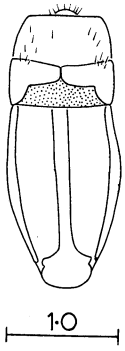
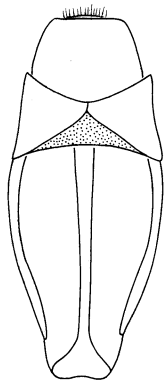
192



193



194



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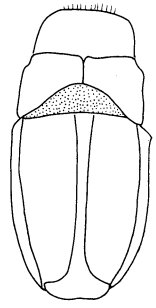

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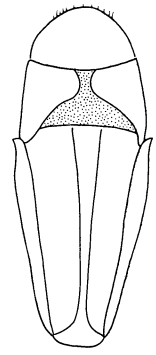

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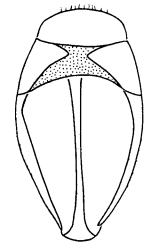

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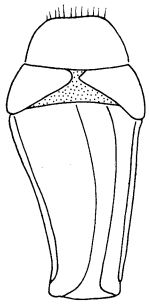

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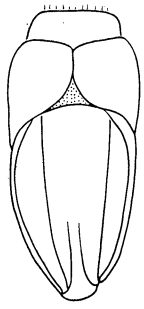

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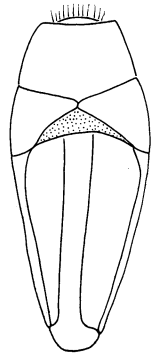

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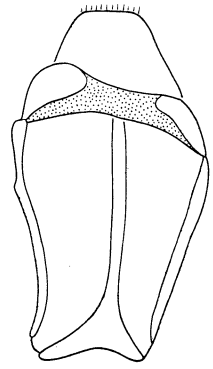

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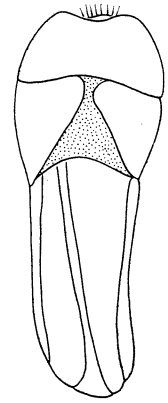
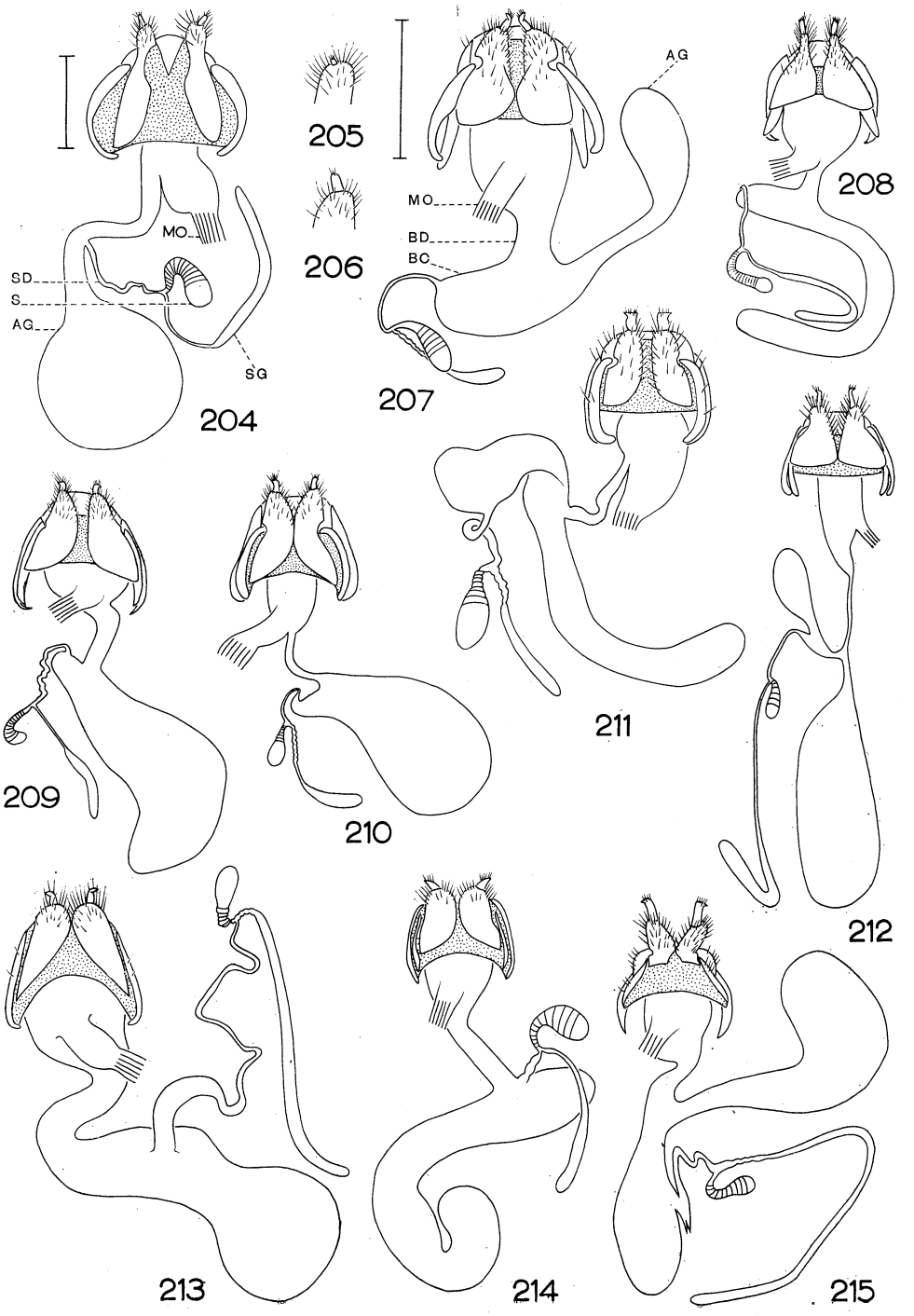


203

FIGS 204, 207–215.—Sclerotized parts of female genitalia (ventral) of New Zealand species of *Ceratognathus*. (204) *C. helotoides* (Tokaanu); (207) *C. irroratus* (Titahi Bay); (208) *C. parrianus* (Wadestown); (209) *C. foveolatus* (Lake Manapouri); (210) *C. reflexus* (Pitt I.); (211) *C. alboguttatus* (Upper Routeburn); (212) *C. macrocerus* (Waimatenui); (213) *C. cylindricus* (Titahi Bay); (214) *C. dispar* (Waiho Gorge); (215) *C. gibbosus* (Karori).

FIGS 205 and 206.—Left styli of specimens of *C. helotoides*—(205) Taieri specimen; (206) Akaroa specimen. (Scales equal to 1.0 mm. Figures 204, 208–210 drawn to same scale; Figs 205–207, 211–215 drawn to same scale.) Abbreviations: AG, accessory gland; BC, bursa copulatrix; BD, bursal duct; MO, median oviduct; S, spermatheca; SD, spermathecal duct; SG, spermathecal gland.


MO
SD
S
AG
SG
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205
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AG
MO
BD
BC
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