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CLASSIFICATION OF BRAZILIAN SPECIES OF *CICINDELA* AND  
PHYLOGENY AND BIOGEOGRAPHY OF SUBGENERA *BRASIELLA*,  
*GAYMARA* NEW SUBGENUS, *PLECTOGRAPHA* AND SOUTH AMERICAN  
SPECIES OF *CYLINDERA* (COLEOPTERA: CICINDELIDAE)

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ABSTRACT

*Brazilian tiger beetles of the tribes Cicindelini, Ctenostomatini, and Megacephalini, subtribes Cicindelina, Odontocheilina and Prothymina, and taxa of the genus Cicindela are distinguished in identification keys. Diagnoses based on adult characteristics, including genitalia of males and females, new for most species, are provided for four subgenera, 12 species groups, and 29 species of Brazilian Cicindela. Species sections consist of nomenclature, recognition, synonyms and types, description, geographical variation, relationships, habitat and period of activity, geographical distribution, lists of localities of examined specimens, distribution map, and figures illustrating taxonomically important external and internal structures.*

*A classification of 61 Brazilian and related Neotropical species of Cicindela is established based on a reconstructed phylogeny employing the methods of Hennig. Brazilian taxa are arranged in sequence according to the reconstructed phylogeny. The four subgenera, species groups, and species recognized are: subgenus Brasiella Rivalier, argentata group— *C. argentata Fabricius*, *C. obscurella Klug*, *C. pretiosa Dokhtourov*; aureola group— *C. amaenula Chaudoir*, *C. aureola Klug*; misella group— *C. dolosula Rivalier*, *C. misella Chaudoir*; minarum group— *C. hamulipennis Horn*, *C. brevipalpis Horn*, *C. banghaasi Horn*, *C. minarum Putzeys*; new subgenus Gaymara (type species: *C. chlorosticta Kollar*); chlorosticta group— *C. chlorosticta Kollar*, *C. staudingeria Horn*, *C. nigroreticulata Horn*, new species *C. paranigroreticulata* (type locality—Tramandai, Rio Grande do Sul); anulipes group— *C. anulipes Horn*; subgenus Plectographa Rivalier; suturalis group— *C. suturalis Fabricius*, *C. nivea Kirby*; melaleuca group— *C. melaleuca Dejean*, *C. patagonica Brullé*; nigrovittata group— *C. nigrovittata Horn*; apiata group— *C. apiata Dejean*; subgenus *Cylindera* Westwood; morio group— *C. kollari Gistel*, *C. confluentesignata**

*Horn*, *C. morio* Klug, *C. marquardt* Horn; *friedenreichi* group— *C. piligera* Horn, *C. obsoletesignata* Horn, *C. friedenreichi* Dokhtouff. Seven new synonymies are proposed with the senior synonym of each combination listed first: *C. argentata* *Fabricius* = *Brasiella pseudoargentata* Mandl; *C. obscurella* Klug = *C. obscurella constricta* Rivalier = *Brasiella chrysocollis* Mandl = *Brasiella pallidipes* Mandl; *C. suturalis* *Fabricius* = *C. trifasciata boliviana* Mandl.

A reconstructed phylogeny of *Cicindela* subgenera which have Brazilian species indicates the following relationships: *Brasiella* as sister group of *Gaymara/Cylindera* lineage, *Gaymara* as sister group of *Plectographa/Cylindera* lineage, and *Plectographa* as sister group of *Cylindera*.

Relationships among species groups in each subgenus are indicated as follows: for *Brasiella*, *argentata* group sister of ancestral lineage of sister groups *viridicollis/hemichrysea*, *aureola* group sister of *cubana/pretiosa* lineage, *misella* group sister of *cubana/horioni* lineage, *monobasic stamatovi* group taxon of uncertain relationships, and *minarum* group sister of *cubana/venezuelensis* lineage; for *Gaymara*, *chlorosticta* group sister of *monobasic anulipes* group; for *Plectographa*, *monobasic halophila* group taxon of uncertain relationships, *suturalis* group sister of *melaleuca* group, *monobasic nigrovittata* group as taxon of uncertain relationships, *apiata* group sister of *siccalacicola/nigrovittata* lineage; and for *Cylindera*, *morio* group as sister of *friedenreichi* group.

Relationships among species of *Brasiella* are: *viridicollis* group, *C. cubana* Leng and Mutchler sister of ancestral lineage of sister species *C. acuniai* Mutchler/*C. viridicollis* Dejean, *C. wickhami* Horn sister of *cubana/viridicollis* lineage; *hemichrysea* group, *C. hemichrysea* Chevrolat sister of ancestral lineage of sister species *C. mendicula* Rivalier/*C. sphaerodera* Rivalier; *argentata* group, *C. argentata* *Fabricius* sister of *venustula/pretiosa* lineage, *C. venustula* Gory sister of ancestral lineage of sister species *C. obscurella* Klug/*C. pretiosa* Dokhtouff; *aureola* group— *C. rivalieri* Mandl sister of *amaenula/horioni* lineage, *C. amaenula* Chaudoir sister of ancestral lineage of sister species *C. aureola* Klug/*C. horioni* Mandl; *misella* group, ancestral lineage of sister species *C. dolosulaffinis* Mandl/*C. tippmanni* Mandl sister of *dolosula/venezuelensis* lineage, *C. venezuelensis* Mandl sister of ancestral lineage of sister species *C. dolosula* Rivalier/*C. misella* Chaudoir, *stamatovi* group, *C. stamatovi* Sumlin relationships uncertain, *minarum* group, *hamulipenis/banghaasi* lineage sister of *minarum/balzani* lineage, *C. banghaasi* Horn sister of ancestral lineage of sister species *C. hamulipenis* Horn/*C. brevipalpis* Horn, *C. balzani* Horn sister of *minarum/insularis* lineage, *C. minarum* Putzeys sister of *nebulosa/insularis* lineage, *C. nebulosa* Bates sister of ancestral lineage of sister species *C. mandli* Brouerius van Nidek/*C. insularis* Brouerius van Nidek.

Relationships among *Gaymara* species are: *anulipes* group, *C. anulipes* Horn sister to *chlorosticta/paranigroreticulata* lineage; *chlorosticta* group, ancestral lineage of sister species *C. chlorosticta* Kollar/*C. staudingeria* Horn sister of ancestral lineage of sister species *C. nigroreticulata* Horn/*C. paranigroreticulata*

*n.sp.*

*Relationships among Plectographa species:* halophila group, *C. halophila* Sumlin relationships uncertain; suturalis group, *C. siccalacicola* Sumlin sister of sinuosa/nahuelbutae lineage, ancestral lineage of sister species *C. sinuosa* Brullé/*C. suturalis* Fabricius sister of hirsutifrons/nahuelbutae lineage, ancestral lineage of sister species *C. hirsutifrons* Sumlin/*C. nivea* Kirby sister of ancestral lineage of sister species *C. ramosa* Brullé/*C. nahuelbutae* Peña; melaleuca group, *C. mixtula* Horn relationships uncertain, ancestral lineage of sister species *C. ritsemai* Horn/*C. drakei* Horn sister of melaleuca/chiliensis lineage, ancestral lineage of sister species *C. melaleuca* Dejean/*C. patagonica* Brullé sister of ancestral lineage of sister species *C. gormazi* Reed/*C. chiliensis* Audouin and Brullé; nigrovittata group, *C. nigrovittata* Horn relationships uncertain; apiata group, *C. eugeni* Castelnau sister of *C. apiata* Dejean.

*Relationships among South American Cylindera species:* morio group, ancestral lineage of sister species *C. kollari* Gistel/*C. malaris* Horn sister of confluentesignata/marquardtii lineage, ancestral lineage of sister species *C. confluentesignata* Horn/*C. granulipennis* Bates sister of *C. morio* Klug/*C. marquardtii* Horn; friendenreichi group, *C. friendenreichi* Dokhtouroff sister of ancestral lineage of sister species *C. piligera* Horn/*C. obsoletesignata* Horn.

The subgenera *Brasiella*, *Gaymara*, *Plectographa* and *Cylindera* are hypothesized to have originated in western Gondwana prior to the formation of South America. Neotropical diversification within subgenera occurred mainly in the northern half of South America during the Tertiary and Pleistocene. Major centers of species concentration of *Brasiella*, *Gaymara*, and *Cylindera* are in open country in the eastern and central Brazilian highlands and that of *Plectographa* in northern Argentina. These centers appear to have been long-standing and the chief sources of dispersal during hospitable climatic and geophysical periods, and into which taxa retreated during climatically hostile periods. Important centers of taxa diversification are eastern and southeastern Brazil, northern Argentina and the Amazon River basin. Vegetational changes in the Amazon basin during the Pleistocene appear to have been the major causes of taxa formation.

## RÉSUMÉ

Les coléoptères Brésiliens de la tribue des Cicindelini, Ctenostomatini, et Megacephalini, du sous-tribue des Cicindelina, des Odontocheilina et des Prothymina, et de la taxa du genre *Cicindela* sont classés en groupes distinctes. Les diagnoses, basés sur les caractéristiques des adultes, mâles et femelles inclus, sont nouveaux pour la plupart des espèces et seront donnés pour quatre sous-espèces, 12 groupes d'espèces et 29 espèces de *Cicindela* Brésiliennes. Le classement des espèces est basé, sur une nomenclature, une identification, des listes de synonymes et de types, une description, une variation géographique, les relations, l'habitat et les périodes d'activités, la distribution géographique, les différentes localisations des espèces examinées, une carte des répartitions, et des chiffres illustrant de façon taxonomiale les importantes structures extérieurs et intérieurs.

Une classification de 61 espèces de *Cicindela* Brésiliennes et Neotropicales apparentées est établie grâce à une phylogénie reconstituée en utilisant les méthodes de Hennig. Les taxa Brésiliennes sont

regroupées selon la phylogénie reconstituée. Les quatre sous-genres (groupes d'espèces), et les organisations des espèces se font comme suit: sous-genre *Brasiella* Rivalier, (groupe *argentata*), *C. argentata* Fabricius, *C. obscurella* Klug, *C. pretiosa* Dokhtouff, (groupe *aureola*), *C. amaenula* Chaudoir, *C. aureola* Klug, (groupe *misella*), *C. dolosula* Rivalier, *C. misella* Chaudoir, (groupe *minarum*), *C. hamulipenis* Horn, *C. brevialpis* Horn, *C. banghaasi* Horn, *C. minarum* Putzeys; nouveau sous-genre *Gaymara* (type d'espèces.--*C. chlorosticta* Kollar), (groupe *chlorosticta*), *C. chlorosticta* Kollar, *C. staudingeria* Horn, *C. nigroreticulata* Horn, la nouvelle espèce *C. paranigroreticulata* (type localité.--*Tramandai*, Rio Grande do Sul), (groupe *anulipes*), *C. anulipes* Horn; sous-genre *Plectographa* Rivalier, (groupe *suturalis*), *C. suturalis* Fabricius, *C. nivea* Kirby, (groupe *melaleuca*), *C. melaleuca* Dejean, *C. patagonica* Brullé, (groupe *nigrovittata*), *C. nigrovittata* Horn, (groupe *apiata*), *C. apiata* Dejean; sous-genre *Cylindera* Westwood, (groupe *morio*), *C. kollari* Gistel, *C. confluentesignata* Horn, *C. morio* Klug, *C. marquardt* Horn, (groupe *friedenreichi*), *C. piligera* Horn, *C. obsoletesignata* Horn, *C. fiedenreichi* Dokhtouff. Sept nouveaux systèmes de synonymes sont proposés avec l'ancien synonyme de chaque combinaisons données auparavant: *C. argentata* *argentata* Fabricius = *Brasiella pseudoargentata* Mandl; *C. obscurella* Klug = *C. obscurella constricta* Rivalier = *Brasiella chrysocolis* Mandl = *Brasiella pallidipes* mandl; *C. suturalis* Fabricius = *C. trifasciata boliviana* Mandl.

Une phylogénie reconstituée des sous-genres *Cicindela* qui comprant les espèces Brésilienne indique les relations suivantes: *Brasiella* comme groupe soeur de la lignée *Gaymara/Cylindera*, *Gaymara* comme groupe soeur de la lignée *Plectographa/Cylindera*, et *Plectographa* comme group soeur de *Cylindera*.

Les relations entre les groupes d'espèces dans chaque sous-genres sont indiquées comme suit: la *Brasiella*, le groupe *argentata* soeur de la lignée ancestrale des groupes soeurs *viridicollis/hemichrysea*, le groupe *aureola* soeur de la lignée *cubana/pretiosa*, le groupe *misella* soeur de la lignée *cubana/horioni*, le groupe monobasique *stamatovi* taxon de relations incertaines, et le groupe *minarum* apparenté de la lignée *cubana/venezuelensis*; la *Gaymara*, le groupe *chlorosticta* soeur du groupe monobasique *anulipes*; la *Plectographa*, le groupe monobasique *halophila* taxon de relations incertaines, le groupe *suturalis* soeur du groupe *melaleuca*, le groupe monobasique *nigrovittata* taxon de relations incertaines, le groupe *apiata* soeur de la lignée *siccalacicola/nigrovittata*; et la *Cylindera*, le groupe *morio* soeur du groupe *friedenreichi*.

Les relations entre les espèces *Brasiella* sont: (groupe *viridicollis*), *C. cubana* Leng et Mutchler soeur de la lignée ancestrale des espèces soeurs *C. acuniai* Mutchler/*C. viridicollis* Dejean, *C. wickhami* Horn soeur de la lignée des *cubana/viridicollis*; (groupe *hemichrysea*), *C. hemichrysea* Chevrolat soeur de la lignée ancestrale des espèces soeurs *C. mendicula* Rivalier/*C. sphaerodera* Rivalier; (groupe *argentata*), *C. argentata* Fabricius soeur de la lignée des *venustula/pretiosa*, *C. venustula* Gory soeur de la lignée ancestrale des espèces soeurs *C. obscurella* Klug/*C. pretiosa* Dokhtouff; (groupe *aureola*), *C. rivalieri* Mandl soeur de la lignée des *amaenula/horioni*, *C. amaenula* Chaudoir soeur de la lignée ancestrale des espèces soeurs *C. aureola* Klug/*C. horioni* Mandl; (groupe *misella*), la lignée ancestrale des espèces soeurs *C. dolosulaffinis* Mandl/*C. tippmanni* Mandl soeur de la lignée des espèces soeurs *C. dolosula* Rivalier/*C. misella* Chaudoir, (groupe *stamatovi*), *C. stomatovi* Sumlin relations incertaines, (groupe *minarum*), la lignée *hamulipenis/banghaasi* soeur de la lignée des *minarum/balzani*, *C. banghaasi* Horn soeur de la lignée ancestrale des espèces soeurs *C. hamulipenis* Horn/*C. brevialpis* Horn, *C. balzani* Horn soeur de la lignée des *minarum/insularis*, *C. minarum* Putzeys soeur de la lignée *nebulosa/insularis*, *C. nebulosa* Bates soeur de la lignée ancestrale des espèces soeurs *C. mandli* Brouerius van Nidek/*C. insularis* Brouerius van Nidek.

Les relations entre les espèces *Gaymara* sont: (groupe *anulipes*), *C. anulipes* Horn soeur de la lignée des *chlorosticta/paranigroreticulata*; (groupe *chlorosticta*), la lignée ancestrale des espèces soeurs *C. chlorosticta* Kollar/*C. staudingeria* Horn soeur de la lignée ancestrale des espèces soeurs *C. nigroreticulata* Horn/*C. paranigroreticulata* n.sp.

Les relations entre les espèces *Plectographa*: (groupe *halophila*), *C. halophila* Sumlin relations incertaines; (groupe *suturalis*), *C. siccalacicola* Sumlin soeur de la lignée des *sinuosa/nahuelbutae*, la lignée ancestrale des espèces soeurs *C. sinuosa* Brullé/*C. suturalis* Fabricius soeur de la lignée des *hirsutifrons/nahuelbutae*, la lignée ancestrale des espèces soeurs *C. hirsutifrons* Sumlin/*C. nivea* Kirby soeur de la lignée ancestrale des espèces soeurs *C. ramosa* Brullé/*C. nahuelbutae* Peña; (groupe *melaleuca*), *C. mixtula* Horn relations incertaines, la lignée ancestrale des espèces soeurs *C. ritsemai* Horn/*C. drakei* Horn soeurs de la lignée des *melaleuca/chiliensis*, la lignée ancestrale des espèces soeurs *C. melaleuca* Dejean/*C. patagonica* Brullé soeurs de la lignée ancestrale des espèces soeurs *C. gormazi* Reed/*C. chiliensis* Audouin et Bruellé; (groupe *nigrovittata*), *C. nigrovittata* Horn relations incertaines; (groupe *apiata*), *C. eugeni* Castelnaud soeur de *C. apiata* Dejean.

Les relations entre les *Cylindera* d'Amérique du sud: (groupe morio, la lignée ancestrale des espèces soeurs *C. kollari* Gistel/*C. malaris* Horn soeur de la lignée des confluentesignata/marquardt, la lignée ancestrale des espèces soeurs *C. confluentesignata* Horn/*C. granulipennis* Bates soeur des *C. morio* Klug/*C. marquardt* Horn; (groupe friedenreichi), *C. friedenreichi* Dokhtoureff soeur de la lignée ancestrale des espèces soeurs *C. piligera* Horn/*C. obsoletesignata* Horn.

Selon une hypothèse les sous-genres *Brasiella*, *Gaymara*, *Plectographa* et *Cylindera* proviennent de l'ouest du Gondwana avant la formation de l'Amérique du sud. La diversification Neotropicale d'une même sous-genre se trouve surtout dans la partie nord de l'Amérique du sud pendant l'ère Tertiaire et le Pleistocène. Les principaux centres de concentration des *Brasiella*, *Gaymara*, et *Cylindera* sont la pleine campagne et l'est et central pays de montagnes Brésiliennes et ceux du *Plectographa* en Argentine du nord. Ces centres semblent avoir été pendant longtemps les principaux points de dispersion des périodes climatiques et géophysique hospitalières et de points de retraite pour les taxa durant les périodes hostiles. D'important centres de diversifications des taxa se situent à l'est et au sud-est du Brésil, en Argentine du nord et dans le bassin Amazonien. Les transformations de la végétation du bassin Amazonien pendant le Pleistocène semblant être à l'origine de la transformation des taxa.

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## INTRODUCTION

Brazilian species of *Cicindela* have not been reviewed as a geographical entity, though they have been treated as part of broad systematic works. Horn (1915, 1926a, 1938) in studies of the world fauna established a preliminary classification based mainly on form, colouration, and pubescence of the exoskeleton of adults. He also included synonymies and geographical distributions. In a 'catalogue' on the evolution of *Cicindela*, Schilder (1953) placed almost all Brazilian species into one genus, *Cicindosa* Motschulsky.

Rivalier (1954, 1955) demonstrated relationships among Neotropical species by comparisons of the internal sac of the median lobe, and divided Brazilian forms of *Cicindela* into *Brasiella* Rivalier and *Cylindera* Westwood. Vidal Sarmiento (1966a, b) also conducted studies of female and male genitalia of genera and species of the Cicindelidae of Argentina, but did include some taxa from Brazil.

More recently in a synopsis of the genera of Neotropical Carabidae Reichardt (1977) presented a brief systematic history of *Cicindela*, and recognized nine 'genera' of Rivalier, two of which are principally Brazilian. Sumlin (1979) reviewed Argentine species of *Cicindela* in which a few Brazilian members were noted and included in a key.

Our study was conducted to develop a taxonomic system and historical synthesis for Brazilian and related Neotropical species of *Cicindela*. The following account includes identification keys, descriptions of taxa, classification and evolutionary history. Determinations of species, species groups, and their relationships, are based on external structures, male genitalia as described by Rivalier (1954, 1955) and Vidal Sarmiento (1966b), and female genitalia which are described herein for the first time for most species. Descriptions of male genitalia not studied by Rivalier (1954, 1955) are included.

## MATERIALS AND METHODS

This study was based on adults of *Cicindela*, those tiger beetles which occupy open habitats, such as bare patches of soil in grasslands, roads and footpaths, river banks, margins of standing fresh water, and sea beaches. About 1200 adult specimens of Neotropical species of *Cicindela* were examined, including Horn types. W.G. Graham and the senior author collected some specimens in the Manaus area. The great majority of specimens were received on loan from private collections and institutions, for which the following codens after Arnett and Samuelson (1969) and Heppner and Lamas (1982) are used in the text.

BMNH British Museum (Natural History), Cromwell Road, London, England SW7 5BD.

BRI Biosystematics Research Institute C.W. Neatby Bldg. Room 3125,

	Research Branch, Ottawa, Ontario, Canada K1A 0C6.
CASC	California Academy of Sciences, Golden Gate Park, San Francisco, California, U.S.A. 94118.
HFHC	Henry H. Howden Collection, Department of Biology, Carleton University, Ottawa, Ontario, Canada K1S 5B6.
ICCM	Carnegie Museum of Natural History, Section of Entomology, 4400 Forbes Avenue, Pittsburgh, Pennsylvania, U.S.A. 15213.
INPA	Instituto Nacional de Pesquisas da Amazonia, Caixa Postal 478, Manaus - 69000, Amazonas, Brazil.
IOC	Instituto Oswaldo Cruz, Rio de Janeiro, Brazil.
IPZE	Akademie der Landwirtschaftswissenschaften der DDR, Institut für Pflanzenschutzforschung Zweigstelle, Abt. Taxonomie der Insekten, Kleinmachnow, Bereich Eberswalde, 13 Eberswalde-Finow 1, Schicklerstrasse 5, Germany.
LEPC	Luis E. Peña Collection, P.O. Box 2974, Santiago, Chile.
MMKC	Michael M. Kaulbars Collection, Department of Biology, Carleton University, Ottawa, Ontario, Canada K1S 5B6.
MNHP	Museum National d'Histoire Naturelle, Entomologie, 45 rue de Buffon, 75005 Paris, France.
MNRJ	Museu Nacional, Quinta da Boa Vista, Rio de Janeiro, RJ-20,000, Brazil.
MZSP	Museu de Zoologie, Universidade de São Paulo, Avenida Nazare, 481 (Agencia Ipiranga), 04263 São Paulo, SP- Brazil.
RRMC	Robert R. Murray Collection, Fort Worth, Texas, U.S.A. 76107.
USNM	United States National Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A. 20560
ZSMS	Zoologische Staatssammlung, Maria-Ward Strasse 1b, D-8000 München 19, Germany.

The various methods and concepts applied in this study have been fairly well established. Structures examined, drawings and measurements, dissections of the male and female genitalia, distribution maps and localities, criteria for species and subspecies, diagnosis of the genus *Cicindela* and reconstruction of phylogenetic system relationships based solely on derived characteristics, have been described elsewhere (Freitag, 1979).

We use special terms that have been applied to features of the male and female genitalia by Rivalier (1954, 1955), Freitag (1965, 1966, 1972), and Vidal Sarmiento (1966a, b, 1967), as shown in Figures 34, 36, 46, 72, 108. A new term, "right bar", is given to a small sclerite which seems to be an extension of the arciform piece on the right side of the internal sac.

Asterisks (\*) listed in the Localities sections indicate place names for which the localities are unknown, and an exclamation mark (!) notes that several specimens were examined but that their sex was not determined.



## CLASSIFICATION

**Notes about taxonomic characteristics**

Characteristics common to adults of Brazilian species of *Cicindela* are those typical of the genus (Horn, 1915; Willis, 1968; Freitag, 1979) as well as the following which characterize most species: scape of antenna with one apical seta; tooth of mentum well developed; pronotum with lateral and front portions setose; lateral portions of metasternum and metacoxa setose; procoxa and mesocoxa setose; and elytra with isodiametric microsculpture and apical microserrulations.

**Taxa of the Brazilian Cicindelidae**

The following keys to the taxa of Brazilian Cicindelidae are constructed from personal examinations of specimens, and diagnostic characteristics given in descriptions, keys and figures by Horn (1915, 1926a, 1938), Rivalier (1954, 1955), Freitag (1966, 1972, 1979), Vidal Sarmiento (1966a, b), Peña (1969), Reichardt (1977), and Sumlin (1979).

**Key to Adults of Tribes of Brazilian Cicindelidae**

- 1 Metepisternum narrow, sulcate for entire length; mesepisternum short; lacinia of maxilla without articulated tooth..... Ctenostomatini
- 1' Metepisternum plate-shaped, not entirely sulcate; mesepisternum elongate; lacinia with articulated tooth..... 2
- 2 (1') Pronotum with anterior lateral angles prominent, projected further forward than anterior margin of prosternum, head wide, eyes small; maxillary palpmere 4 in most members of most taxa shorter than maxillary palpmere 3; body without pubescence..... Megacephalini
- 2' Pronotum with anterior lateral angles not prominent; head with large prominent eyes; maxillary palpmere 4 longer than maxillary palpmere 3; body with pubescence in members of most taxa..... Cicindelini

**Key to Adults of Subtribes and Subgenera of *Cicindela* of Brazilian Cicindelini**

- 1 Pubescence generally present on head, thorax, and abdomen in members of most taxa; or posterior 0.33 of elytron with pale markings ..... subtribe Cicindelina; genus *Cicindela*..... 3
- 1' Pubescence generally absent from head, thorax, and abdomen in members of most taxa; posterior 0.33 of elytron without pale markings ..... 2
- 2 (1') Elytral epipleuron and free lateral margin of hind coxa glabrous

- ..... subtribe Prothymina
- 2' Elytral epipleuron glabrous or pubescent, and free lateral margin of hind coxa pubescent..... subtribe Odontocheilina
- 3 (1) Pale maculations of elytra various, from complete and narrow to reduced and incomplete; labrum tridentate in most species; median lobe of male with apical hook in specimens of most species ..... 4
- 3' Pale maculations of elytra broad to extensive in specimens of most species, or depressed, or absent, or discontinuous giving spotted appearance; labrum unidentate or multidentate in specimens of most species; median lobe of male tapered, without hook ..... 5
- 4 (3) Body size small, most adults less than 7.5 mm long; labrum with five to 10 (most commonly eight) submarginal setae; pronotum narrow; membrane in place of oviduct sclerite; ventral sclerite of bursa without posterior projections .....  
.....subgenus *Brasiella* Rivalier, p. 254
- 4' Body size large, most adults 8.0-12.0 mm long (*C. anulipes* is 7.0-7.5 mm); labrum with four to six (seven in a few specimens) submarginal setae; pronotum broad; oviduct sclerite present; ventral sclerite of bursa with setose lateral posterior projections..... subgenus *Gaymara* n. subg., p. 278
- 5 (3') Pale maculations of elytra broad to extensive, or depressed, or absent; head glabrous in specimens of all but one species (gena sparsely pilose in *C. confluentesignata*); thoracic pleuron and sternum glabrous or moderately pilose; labrum unidentate or multidentate; internal sac of median lobe of male lacking dorsal spatulate sclerite..... subgenus *Cylindera* Westwood, p. 317
- 5' Pale maculations of elytra well developed in specimens of most species, tendency to be discontinuous, appearance spotted; head with setae (glabrous in *C. suturalis*); thoracic pleuron including proepisternum and sternum densely pilose; internal sac of median lobe of male with dorsal spatulate sclerite.....  
..... subgenus *Plectographa* Rivalier, p. 289

#### Key to the Brazilian species of *Cicindela*

- 1 Head with setae on either the vertex, frons, clypeus or genae, fine in some specimens and not obvious or abraded ..... 2
- 1' Head glabrous (except for one or two supraorbital setae near the inner margin of each eye) ..... 8
- 2 (1) Dense appressed setae on vertex, frons, clypeus, genae and most of the rest of the body; elytra completely or almost

- without ground colour (Figs. 91a, b); body size 9.0-13.5 mm; distributed from Espirito Santo, Brazil, south to Argentina .....  
 .....*C. nivea* Kirby, p. 300
- 2' Combination of characters not as above ..... 3
- 3 (2') Body length 8.5-11.0 mm; elytra with ground colour very dark brown to black, dull, maculations broad, continuous away from lateral margin, row of large foveae with umbilicate centers near suture (Fig. 92); distributed in coastal regions in southernmost portion of Rio Grande do Sul, Argentina, and Chile .....  
 .....*C. melaleuca* Dejean, p. 302
- 3' Combination of characters not as above ..... 4
- 4 (3') Labrum of most specimens with seven to nine submarginal setae ..... 5
- 4' Labrum of most specimens with fewer than seven submarginal setae ..... 6
- 5 (4) Body length 6.5-7.5 mm; elytra with ground colour brown, dull, marginal band and apical lunule broad, middle band broad, oblique (Fig. 32); coupling sulcus of mesepisternum of female deep round pit; distributed in Matto Grosso .....  
 .....*C. banghaasi* Horn, p. 276
- 5' Body length 9.0-10.0 mm; elytra with ground colour brown, glossy, maculations broad, continuous along lateral margin (Figs. 93a, b); coupling sulcus deep groove; distributed from Rio Grande do Sul south to Patagonia .....  
 .....*C. patagonica* Brullé, p. 303
- 6 (4') Dorsum coppery brown, slightly glossy; elytra with broad and continuous pale maculations (Figs. 130a-c); genae sparsely setose, frons and clypeus glabrous; antennae with articles 5-11 pale; labrum with margin irregular, unidentate in most specimens; in some, seven dentate, with margin incised by setiferous punctures (Figs. 116a-c); distributed in Minas Gerais, Uruguay, Argentina, Paraguay .....  
 .....*C. confluentesignata* Horn, p. 319
- 6' Combination of characters not as above ..... 7
- 7 (6') Ground colour dull (matte) black; one or two small pale spots on elytra (Fig. 94); vertex, frons, and genae sparsely setose; coupling sulcus of mesepisternum of female shallow, wide, almost absent; distributed in Minas Gerais.....  
 .....*C. nigrovittata* Horn, p. 304
- 7' Ground colour black (not matte); maculations of elytra reduced (Figs. 65a-c); vertex, frons clypeus, and genae sparsely setose; tuft of setae on front inner margin of each eye; coupling sulcus

	elongate groove with deep middle; distributed in Rio Grande do Sul.....	<i>C. paranigroreticulata</i> new species, p. 287	
8	(1')	Labrum edentate or with very small single tooth (Figs. 2, 3, 5).....	9
8'		Labrum either unidentate or multidentate.....	11
9	(8)	Labrum with anterior margin broadly protruded in center (Figs. 3a-c); elytra dark brown, purplish reflections in few specimens, with short wide transverse middle band, small subapical spot of humeral lunule present in most specimens, and with subapical spot, (Figs. 25a-c); distributed in Amazon basin .....	
		..... <i>C. pretiosa</i> Dokhtoureff, p. 269	
9'		Labrum with anterior margin straight (Figs. 2, 5); pattern of elytral markings as in Figures 24, 27.....	10
10	(9')	Dorsum bright to dark red-coppery, elytral pattern with humeral spot, middle band and subapical spot (Fig. 27); distributed in inland southern Brazil.....	<i>C. aureola</i> Klug, p. 271
10'		Dorsum black to dark brown; elytral pattern almost effaced (Figs. 24a, b); distributed in northern Argentina, Bolivia, Paraguay, Uruguay, southern Brazil .....	
		..... <i>C. obscurella</i> Klug, p. 267	
11	(8')	Labrum at least 5-dentate .....	12
11'		Labrum at most tridentate .....	15
12	(11)	Body length 6.0 mm; body dull black; labrum indistinctly five dentate with six submarginal setae, with middle four setae close to margin (Fig. 9); elytron without shoulder, pattern absent (Fig. 31); distributed in Matto Grosso, .....	
		..... <i>C. brevipalpis</i> Horn, p. 276	
12'		Combination of characters not as above .....	13
13	(12')	Ground colour dull brown to black with green head and pronotum; elytra with broad apical and humeral lunules (Figs. 132a, b); tooth of mentum short; labrum 5-dentate (Figs. 118a, b); distributed in Matto Grosso .....	<i>C. marquardtii</i> Horn, p. 321
13'		Ground colour black; elytra various, from immaculate to fully maculate (Figs. 131, 133); labrum seven to 12 dentate (Figs. 117, 119); tooth of mentum well developed .....	14
14	(13')	Elytra with maculations reduced to three spots, each in depression, large punctures along suture, large depression in basal 0.33 (Figs. 133a, b); articles 5-6 of antenna dark; labrum seven dentate with six marginal setae (Figs. 119a, b); coupling sulcus of mesepisternum of female in form of groove with central pit; distributed in Minas Gerais .....	
		..... <i>C. piligera</i> Horn, p. 322	
14'		Elytra various, from immaculate to fully maculate (Figs.	

- 131a-e); articles five or six of antenna pale; labrum elongate, seven to 12 dentate with eight to 10 marginal setae (Figs. 117a-e); coupling sulcus broad groove; distributed from Amazon River to Matto Grosso..... *C. morio*, Klug, p. 320
- 15 (11') Elytra with dark lines in form of reticulated pattern against lighter brown and coppery ground colour, humeral lunule short, middle band markedly curved (Figs. 64a, b); labrum unidentate or weakly tridentate with four submarginal setae (Figs. 54a, b); distributed in inland Rio Grande do Sul .....  
..... *C. nigroreticulata* Horn, p. 286
- 15' Combination of characters not as above ..... 16
- 16 (15') Head and pronotum deeply rugose and bright coppery with faint green reflections in some specimens; elytra with middle band narrow and strongly oblique as in Figures 62, 63 ..... 17
- 16' Head and pronotum not deeply rugose and bright coppery; elytra with middle band not oblique ..... 18
- 17 (16) Body length 8.0-8.5 mm; pattern of elytral maculations as in Figures 62a, b; distributed in central and southeastern Brazil, northeastern Argentina, Paraguay.....  
..... *C. chlorosticta* Kollar, p. 284
- 17' Body length 10.0-12.0 mm; pattern of elytral maculations as in Figures 63a, b; distributed in southeastern Brazil, northern Argentina, Uruguay ..... *C. staudingeria* Horn, p. 285
- 18 (16') Labrum elongate, convex, with three small teeth, and four submarginal setae (Fig. 56); proepisternum with deep and evenly distributed punctures; elytra with reduced maculations (Fig. 66); distributed in Goiás, Matto Grosso, Minas Gerais, Rio Grande do Sul ..... *C. anulipes* Horn, p. 288
- 18' Combination of characters not as above ..... 19
- 19 (18') Labrum distinctly tridentate (Figs. 1, 4, 6, 7) ..... 20
- 19' Labrum unidentate or obscurely tridentate ..... 23
- 20 (19) Labrum distinctly narrow throughout, central portion of front margin not protruded, central tooth small (Figs. 7a, b); humeral spot of elytron small, on latero-ventral side of shoulder, not evident in dorsal view; distributed in southern Matto Grosso near the Bolivian border, Central America and northwestern South America (probably east of the Andes) south to southwestern Brazil and Argentina.....  
..... *C. misella* Chaudoir, p. 274
- 20' Combination of characters not as above ..... 21
- 21 (20') Elytra slightly glossy brown, maculations broad, middle band slightly oblique (Fig. 26); labrum with broadly rounded teeth,

- eight submarginal setae (Fig. 4); distributed inland from Matto Grosso north to Amazon River .... *C. amaenula* Chaudoir, p. 270
- 21' Elytra dull, brown to black, maculations narrower or more reduced; teeth of labrum narrower (Figs. 1, 6) ..... 22
- 22 (21') Elytron with humeral spot, subhumeral spot distinct (Figs. 23a-e); small bell-shaped unpigmented area on posterior margin of sternum 5 of females distributed from Brazil north to Mexico, south to Argentina ..... *C. argentata* Fabricius, p. 265
- 22' Elytron with humeral spot absent, subhumeral spot tiny (Fig. 28); bell-shaped unpigmented area on posterior margin of sternum 5 of females absent; distributed from eastern Brazil west to Colombia ..... *C. dolosula* Rivalier, p. 273
- 23 (19') Elytra with pale maculations widely expanded, continuous in some specimens, humeral lunule oblique, punctation very large and deep (Figs. 129a, b); articles 5-11 of antennae pale; body pubescence moderately dense; labrum distinctly unidentate with five or six sub-marginal setae (Figs. 115a, b); distributed in central Brazil ..... *C. kollari* Gistel, p. 317
- 23' Combination of characters not as above ..... 24
- 24 (23') Elytra black, maculations obsolete and depressed, with broad punctures near median suture and shoulders (Fig. 134); labrum unidentate, dark at base, six submarginal setae (Fig. 120); distributed in Santa Catarina, northern Argentina ..... *C. obsoletesignata* Horn, p. 323
- 24' Combination of characters not as above ..... 25
- 25 (24') Body length 6.0 mm; elytra dull dark brown, maculations largely effaced (Fig. 30); labrum unidentate with five to seven submarginal setae (Fig. 8); distributed in Goiás ..... *C. hamulipenis* Horn, p. 275
- 25' Combination of characters not as above ..... 26
- 26 (25') Elytra with maculations complete and continuous or broad (Figs. 90, 95)..... 27
- 26' Elytra with maculations reduced (Figs. 33, 121)..... 28
- 27 (26) Elytra with ground colour dull dark brown, maculations broad, lacking marginal band (Figs. 95a-d); labrum unidentate, tooth prominent, or obscurely tridentate, seven to 13 submarginal setae (Figs. 83a-d); coupling sulcus of mesepisternum of female broad groove; distributed in coastal and inland Rio de Janeiro, Minas Gerais, Matto Grosso, Rio Grande do Sul, northern Argentina ..... *C. apiata* Dejean, p. 305
- 27' Elytra with ground colour glossy, with coppery, green and blue (in some specimens) reflections, maculations complete and

- continuous, middle band sinuate (Figs. 90a-e); labrum unidentate, with 8-10 submarginal setae (Figs. 78a-e); coupling sulcus deep sinuate groove; distributed from southern Brazil north to Trinidad and southern Caribbean Islands.....  
 .....*C. suturalis* Fabricius, p. 298
- 28 (26') Elytra dull, black, apical lunule with recurved hook at distal end (Figs. 33a, b); labrum short almost tridentate, with seven to 12 submarginal setae (Figs. 11a, b); coupling sulcus of mesepisternum of female deep groove with central pit; distributed in Espirito Santo, Minas Gerais, Matto Grosso, São Paulo .....*C. minarum* Putzeys, p. 277
- 28' Elytra slightly glossy, black, middle band, especially apical end, depressed (Figs. 135a, b); labrum unidentate with seven of eight setae almost marginal (Figs. 121a, b); coupling sulcus long sinuate groove; distributed in Rio Grande do Sul, Santa Catarina .....*C. friedenreichi* Dokhtouroff, p. 324

#### Subgenus *Brasiella* Rivalier

Genus *Brasiella* Rivalier, 1954: 261 (TYPE SPECIES, *Cicindela argentata*, by original designation).  
 Rivalier, 1955: 79. Reichardt, 1977: 374.

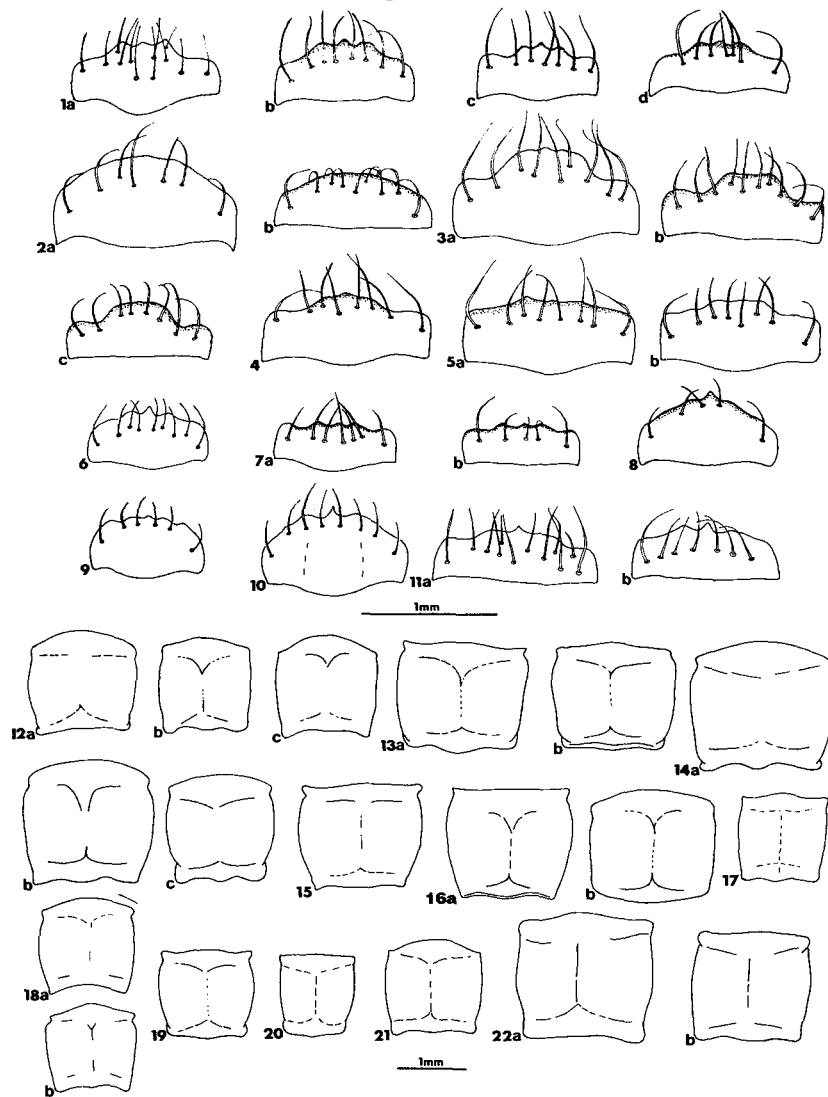
*Brasiella* Mandl, 1963: 581; 1973: 270 (incorrect subsequent spelling).

*Recognition.*— Adults of this subgenus are distinguished by the five characters given in couplet 4 of the key. In addition the head is glabrous (except for *C. banghaasi*); labrum tridentate, unidentate, edentate, or indistinctly five dentate; pale maculations of elytra are complete and narrow in most species or reduced or completely absent; middle of abdominal sterna pubescent; apex of median lobe of the male is hooked in most species, and central plate and flagellum are absent in the internal sac; the spermatheca and duct of the female together are approximately 1.0-1.5 mm long.

*Species groups.*— This subgenus has seven species groups that include 29 species. Six groups are found in South America, of which four are in Brazil, *argentata* group, *aureola* group, *misella* group, and *minarum* group.

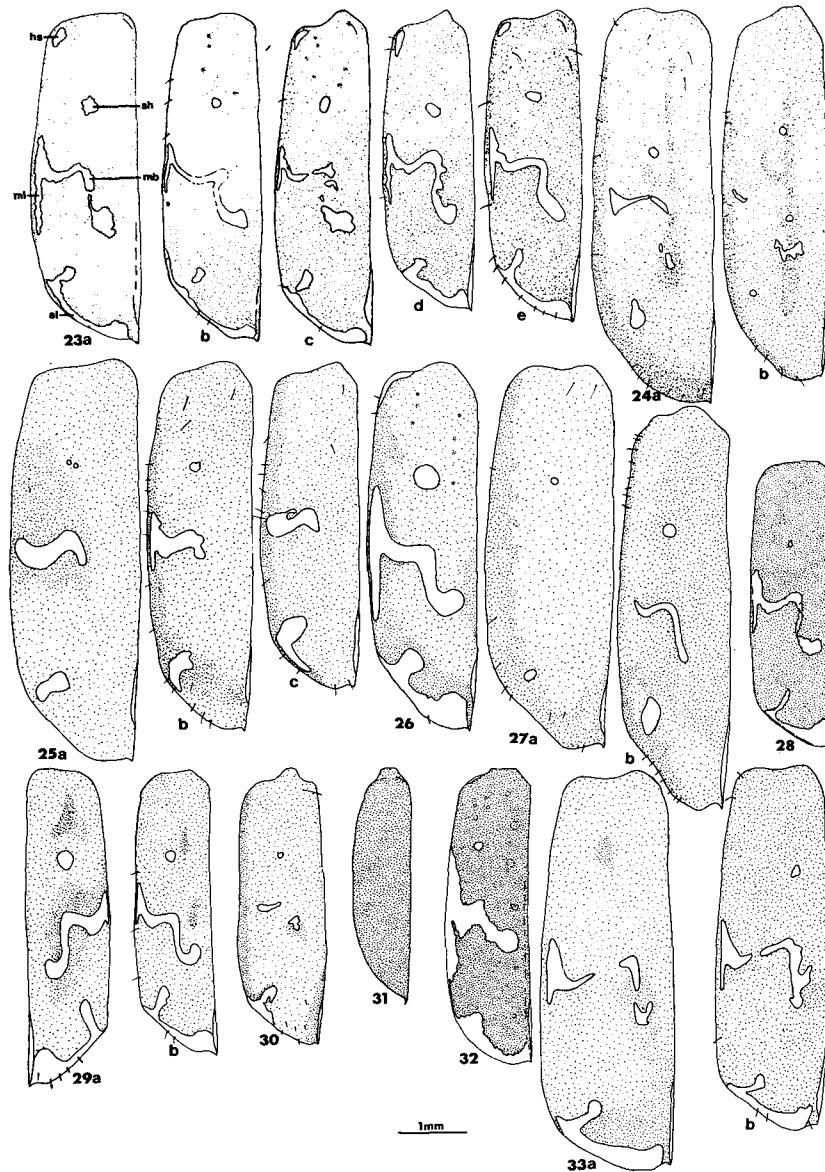
*Geographical distribution.*— The geographical range of this subgenus extends from northern Argentina northward to southwestern United States and the West Indies. In Brazil most taxa in this subgenus are concentrated south of the Amazon River in the Brazilian Highlands and southern parts of the Amazon basin.

*Phylogenetic relationships.*— Subgenus *Brasiella* is sister to the lineage that gave rise to subgenera *Gaymara*, *Plectographa*, and *Cylindera*.

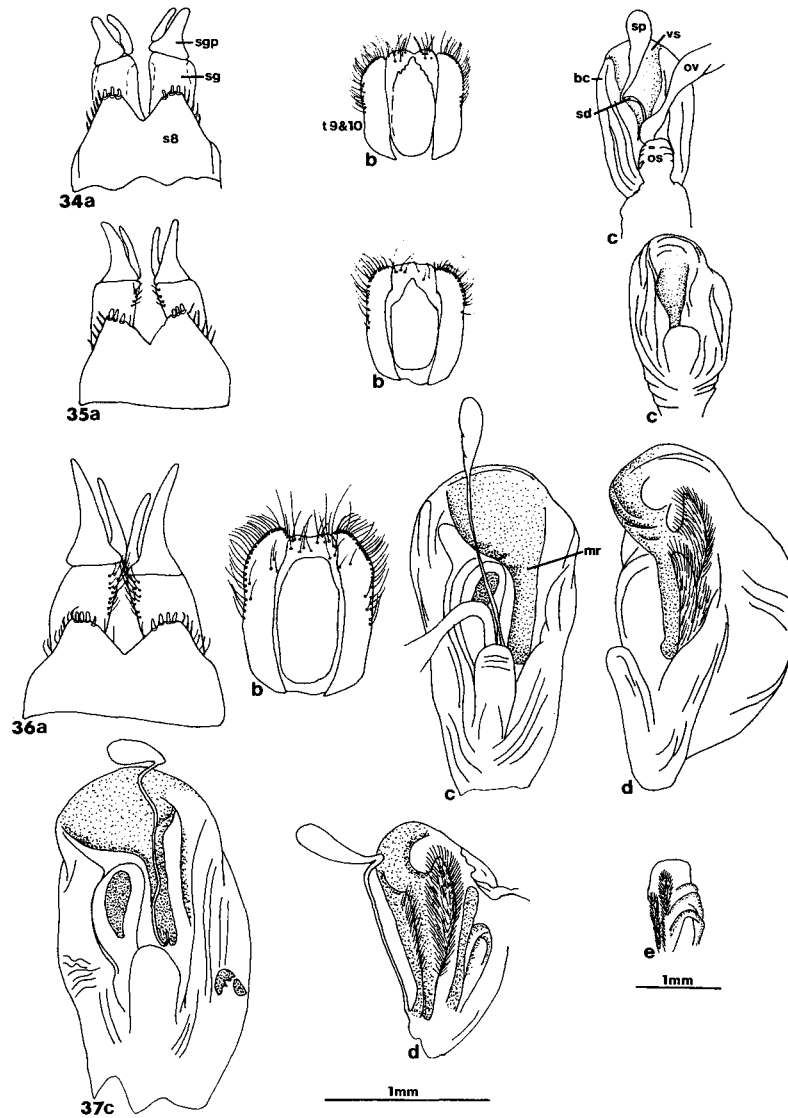


Figs. 1-11. Labrum, dorsal aspect. 1, *Cicindela argentata* Fabricius: (a) female, Estac, S.P.; (b) female, Ypiranga, S.P.; (c) male, Arinos, M. Gerais; (d) male, 40 km w. Manaus, Am.; 2, *C. obscurella* Klug, Montevideo, Uruguay: (a) female; (b) male; 3, *C. pretiosa* Dokhtouroff, Manaus, Am.: (a) female; (b), (c) male; 4, *C. amaenula* Chaudoir, female, near Amazon River; 5, *C. aureola* Klug, female: (a) São Paulo, S.P.; (b) Vacaria, M. Grosso; 6, *C. dolosula* Rivalier, male, Chapada, Go.; 7, *C. misella* Chaudoir, Bugaba, Colombia: (a) female; (b) male; 8, *C. hamulipenis* Horn, male, Dianopolis, Go.; 9, *C. brevipalpis* Horn, male, Vacaria, M. Grosso; 10, *C. banghaasi* Horn, female, Cuyaba, M. Grosso; 11, *C. minarum* Putzeys: (a) female, Vacaria, M. Grosso; (b) male, Espírito Santo. Figs. 12-22. Pronotum, dorsal aspect. 12, *C. argentata* Fabricius: (a) female, Ypiranga, S.P.; (b) male, Arinos, M. Gerais; (c) male, 40 km w. Manaus, Am.; 13, *C. obscurella* Klug, Montevideo, Uruguay: (a) female; (b) male; 14, *C. pretiosa* Dokhtouroff, Manaus, Am.: (a) female; (b), (c) male; 15, *C. amaenula* Chaudoir, female, near Amazon River; 16, *C. aureola* Klug, female: (a) São Paulo, S.P.; (b) Vacaria, M. Grosso; 17, *C. dolosula* Rivalier, male Chapada, Go.; 18, *C. misella* Chaudoir, Bugaba, Columbia: (a) female; (b) male; 19, *C. hamulipenis* Horn, male, Dianopolis, Go.; 20, *C. brevipalpis* Horn, male, Vacaria, M. Grosso; 21, *C. banghaasi* Horn, female, Cuyaba, M. Grosso; 22, *C. minarum* Putzeys; (a) female, Vacaria, M. Grosso; (b) male, Espírito Santo.

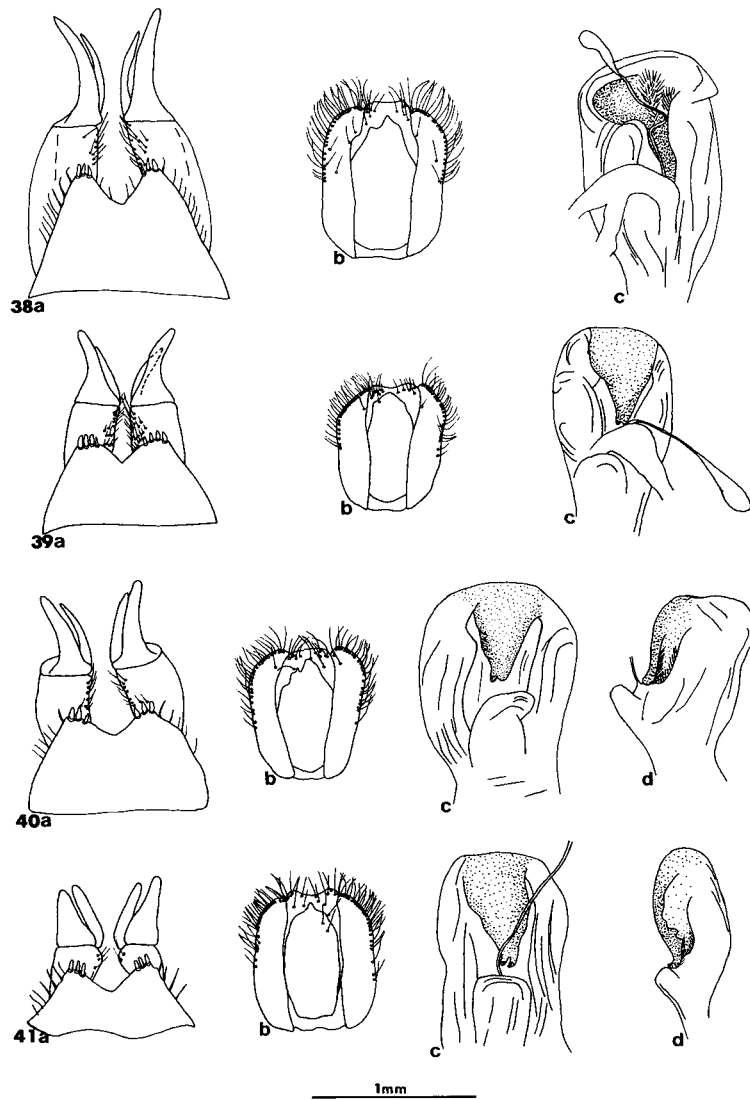




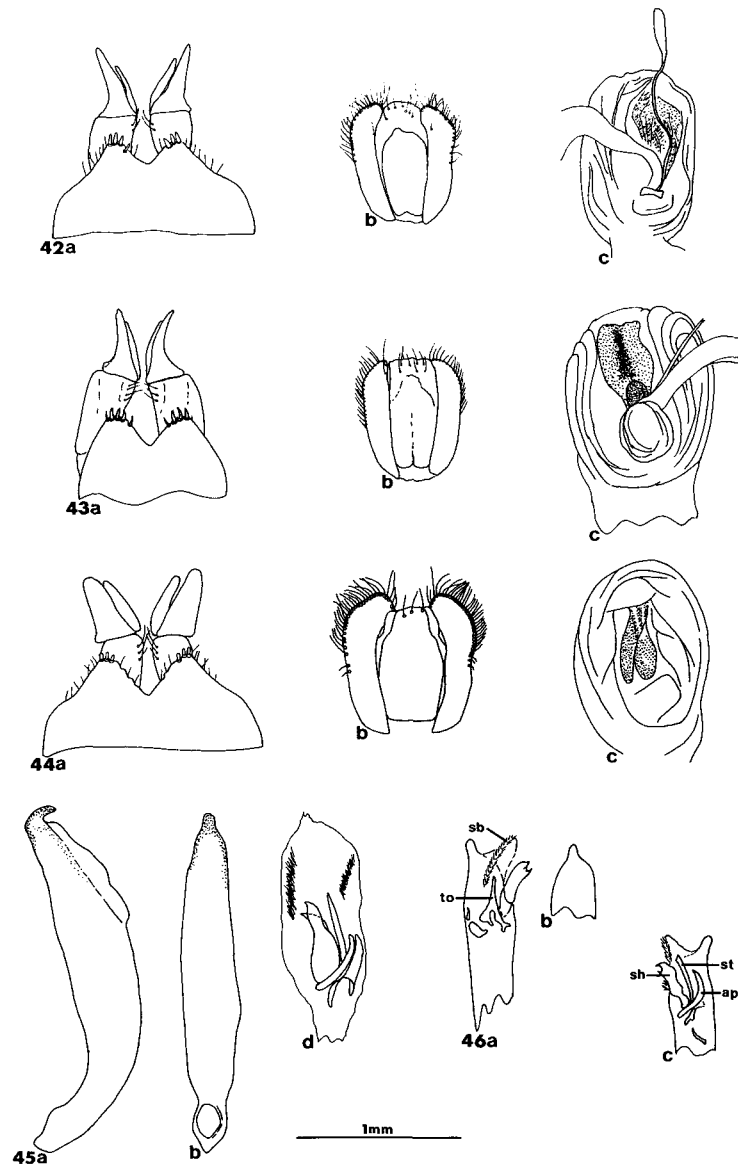
Figs. 23-33. Elytron, dorsal aspect. 23, *Cicindela argentata* Fabricius; (a) female, Estac, S.P., apical lunule (*al*), humeral spot (*hs*), middle band (*mb*), marginal band or lunule (*ml*), subhumeral spot (*sh*); (b), (c), female, Ypiranga, S.P.; (d) male, Arinos, M. Gerais; (e) male, 40 km w. Manaus, Am.; 24, *C. obscurella* Klug, Montevideo, Uruguay: (a) female; (b) male; 25, *C. pretiosa* Dokhtouroff, Manaus, Am.: (a) female; (b), (c) male; 26, *C. amaenula* Chaudoir, female, near Amazon River; 27, *C. aureola* Klug, female: (a) São Paulo, S.P.; (b) Vacaria, M. Grosso; 28, *C. dolosula* Rivalier, male, Chapada, Go.; 29, *C. misella* Chaudoir, Bugaba, Colombia: (a) female; (b) male; 30, *C. hamulipennis* Horn, male, Dianopolis, Go.; 31, *C. brevipalpis* Horn, male, Vacaria, M. Grosso; 32, *C. banghaasi* Horn, female, Cuyaba, M. Grosso; 33, *C. minarum* Putzeys: (a) female, Vacaria, M. Grosso; (b) male, Espírito Santo.



Figs. 34–37. Female genitalia: (a) sternum 8 (*s8*), second gonocoxa (*sg*), second gonapophyses (*sgp*), ventral aspect; (b) syntergum 9 and 10 (*t9&10*), dorsal aspect; (c) bursa copulatrix (*bc*), median ridge (*mr*), oviduct sclerite (*os*), oviduct (*ov*), spermatheca (*sp*) and duct (*sd*), ventral sclerite (*vs*), ventral aspect; (d) bursa copulatrix left lateral aspect; (e) bursa copulatrix dorsal aspect. *Cicindela argentata* Fabricius: 34, Estac, S.P.; 35, Ypiranga, S.P.; 36, 37, *C. obscurella* Klug, Montevideo, Uruguay.



Figs. 38–41. Female genitalia: (a) sternum 8, second gonocoxa, second gonapophyses, ventral aspect; (b) syntergum 9 and 10, dorsal aspect; (c) bursa copulatrix, median ridge, oviduct sclerite, oviduct, spermatheca and duct, ventral sclerite, ventral aspect; (d) bursa copulatrix left lateral aspect. 38, *Cicindela pretiosa* Dokhtouroff, Manaus, Am; 39, *C. amaenula* Chaudoir, near Amazon River; *C. aureola* Klug, 40, São Paulo, S.P.; 41, Vacaria, M. Grosso.



Figs. 42-44. Female genitalia: (a) sternum 8, second gonocoxa, second gonapophyses, ventral aspect; (b) syntergum 9 and 10, dorsal aspect; (c) bursa copulatrix, median ridge, oviduct sclerite, oviduct, spermatheca and duct, ventral aspect. 42, *Cicindela misella* Chaudoir, Bugaba, Columbia; 43, *C. banghaasi* Horn, Cuyaba, M. Grosso; 44, *C. minarum* Putzeys, Vacaria, M. Grosso. Figs. 45-46. Male genitalia: median lobe (a) right lateral aspect; (b) dorsal aspect; (c) left lateral aspect; (d) internal sac, arciform piece (*ap*), setal brush (*sb*), shield (*sh*), stylet (*st*), tooth (*to*). 45, *C. hamulipennis* Horn, Dianopolis, Go.; 46, *C. brevipalpis* Horn, Vacaria, M. Grosso.



Fig. 47. Map showing the geographical distribution of the species *Cicindela argentata* Fabricius. Open circles represent state records.



Fig. 48. Map showing the geographical distribution of the species *Cicindela obscurella* Klug (●), and *C. pretiosa* Dokhtouroff (■). Open circles represent state records of *C. obscurella* Klug.





Fig. 50. Map showing the geographical distribution of the species *Cicindela dolosula* Rivalier (●), and *C. misella* Chaudoir (■). Open circle and square represent state records for *C. dolosula* Rivalier, and *C. misella* Chaudoir respectively.





Fig. 51. Map showing the geographical distribution of the species *Cicindela hamulipennis* Horn (●), *C. brevipalpis* Horn (■), *C. banghaasi* Horn (▲), and *C. minarum* Putzeys (▼).

The *argentata* group

Adults of this group are characterized by elytral foveae not obvious, and unpigmented bell-shaped spot on abdominal sternum 5 of the female. The group has four species, three of which are found in Brazil, *C. argentata*, *C. obscurella*, and *C. pretiosa*. The geographical range of the *argentata* group extends from northern Argentina northward to northern South America and the Lesser Antilles. The *argentata* group is a close relative of the *viridicollis* and *hemichrysea* groups.

*Cicindela (Brasiella) argentata* Fabricius

Figs. 1, 12, 23, 34, 47

*Cicindela argentata argentata* Fabricius, 1801: 242 (TYPE LOCALITY, in America meridionali). - Herbst, 1806: 208. - Dejean, 1825: 147; 1831: 215. Kirsch, 1873: 125. - Bates, 1881: 14. - Horn, 1896a: 354; 1903: 334; 1904: 86; 1906: 87-91; 1915: 406; 1923: 111; 1926a: 308; 1938: 52. Varas Arangua, 1925: 37. - Barattini, 1929: 1218. - Blackwelder, 1944: 17. - Cazier, 1954: 286. - Rivalier, 1954: 261-263; 1955: 79-80; 1970: 857. Brouerius van Nidek, 1956: 320. - Mandl 1956: 389; 1963: 581; 1964: 16; 1967: 437, 439; 1973: 290. Vidal Sarmiento, 1966a: 256-257; 1966b: 32-33. - Balazuc and Chalumeau, 1978: 22. - Sumlin, 1979: 102.

*Cicindela guerini* Gory, 1833: 178 (TYPE LOCALITY, Cayenne). - Horn, 1896a: 354; 1915: 406; 1926a: 308. - Blackwelder, 1944: 17.

*Cicindela lucorum* Gistel, 1837: 71 (TYPE LOCALITY, in Cayenna). - Horn, 1915: 406; 1926a: 308. - Blackwelder, 1944: 17.

*Cicindela egaensis* Thomson, 1857: 130 (TYPE LOCALITY, Ega, Amazone supér.). - Horn, 1915: 406; 1926a: 308. - Blackwelder, 1944: 17.

*Brasiella pseudoargentata* Mandl, 1963: 582 (TYPE LOCALITY, Jacaré P.N. Xingu, M. Grosso, Bras.).  
NEW COMBINATION AND SYNONYMY.

*Cicindela argentata pallipes* Fleutiaux and Sallé, 1889: 359 (TYPE, sex undetermined, in the MNHP general collection bearing the following label: "Guadeloupe Delauney/*C. argentata* F., v. *pallipes* (ch<sup>2</sup>)/Museum Paris Box collection Fleutiaux/Type" (black letters on red label); (TYPE LOCALITY, Guadeloupe). - Horn, 1903: 334; 1915: 406; 1926a: 308. - Leng and Mutchler, 1916: 696. - Blackwelder, 1944: 17. - Rivalier, 1955: 80.

*Cicindela argentata umbrogemmata* Horn, 1906: 87 (TYPE LOCALITY, Posorja, Ecuador (Campos)); 1915: 407; 1926a: 308; 1938: 52. - Blackwelder, 1944: 17.

*Cicindela argentata macella* Rivalier, 1955: 80 (TYPE, a male in the MNHP general collection bearing the following label: "Muséum Paris de la Mana Leschor/ penis 873 Rivalier/*argentata* s.s. *macella* mihi. E. Rivalier det/TYPE" (black letters on red label); TYPE LOCALITY, Brésil).

*Cicindela argentata semicircumscripta* Mandl, 1958: 23 (TYPE LOCALITY, Santiago del Estero, El Pinto). - Sumlin, 1979: 103.

*Cicindela argentata ecuadorensis* Mandl, 1973: 290 (TYPE LOCALITY, Ecuador, San Anton. Curaray).

**Recognition.**— Specimens of *C. argentata* are distinguished from those of the similar species *C. obscurella* by a combination of the following characteristics: in most specimens maculations of elytra well developed with complete marginal band and humeral spot, subapical spot and apical lunule (Figs. 23a-e); labrum of average length and obsoletely to strongly tridentate with middle tooth well developed in most specimens (Figs. 1a-d); sides of inside of bursa copulatrix in females lightly sclerotized and brushes of setae absent (Figs. 34c, 35c). In addition, the shapes of the sclerites of the internal sac of the median lobe of the two above species differ (Rivalier, 1955: 81,84; Vidal Sarmiento, 1966b: 33). Also see Recognition section

for *C. misella* and *C. dolosula*.

*Synonyms and Types*.— We have not seen types of the *C. argentata* complex except for that of *C. argentata macella* Rivalier and *C. argentata pallipes* Fleutiaux and Sallé. Names are based upon comparison of original descriptions with specimens on loan. Rivalier (1955: 80) is correct in stating that *C. taitiensis* Boheman is a cicindelid from Tahiti which is not an element of the American fauna. The name *C. pseudoargentata* Mandl has been assigned to small specimens of *C. argentata*.

*Description*.—

*Body length*. 6.0-8.0 mm M and F.

*Body color*. Head, pronotum and elytra dull to slightly glossy, black to coppery brown, elytra of some specimens with green reflections. Venter, pleuron and sides of head with green, blue, and coppery reflections.

*Body setae*. Proepisternum and mesepisternum sparsely setose, metepisternum more densely setose; lateral margins of abdominal sterna 1-6 setose.

*Other external features*. Labrum of average length, tridentate, with eight submarginal setae, ranging in number from five to 12 (Figs. 1a-d). Pronotum narrow, sutures shallow (Figs. 12a-c). Coupling sulcus of female shallow to moderately deep groove, with deeper pit in middle. Apex of front trochanters with one seta. Apices of elytra slightly to not recurved. Pattern of elytral maculations with humeral lunule discontinuous, humeral spot on shoulder in most specimens, humeral subapical spot present; marginal band in most specimens; middle band complete or discontinuous; apical lunule complete or discontinuous (Figs. 23a-e). Punctures of elytra large, shallow, with green (mainly) and coppery reflections.

*Female genitalia*. Sternum 8 with deep and broad V-shaped posterior emargination; apices moderately rounded, each with three short stout setae (Figs. 34a, 35a). Second gonapophyses broad, medial portion almost as long as lateral portion (Figs. 34a, 35a). Syntergum 9 and 10 as in Figures 34b, 35b. Ventral sclerite broad, lightly sclerotized, median ridge absent; inside lateral walls of bursa slightly sclerotized (Figs. 34c, 35c). Thick membrane in place of oviduct sclerite (Figs. 34c, 35c). Length of spermatheca and duct *ca* 1.0 mm. See also Vidal Sarmiento (1966a; 256).

*Male genitalia*. Male genitalia have been described by Rivalier (1955: 81) and Vidal Sarmiento (1966b: 33).

*Geographical Variation and Subspecies*.— Variable elytral maculations include the humeral spot almost absent or very well marked, and marginal band absent or reduced (few specimens) or well marked (most specimens). The middle band is discontinuous in some specimens. A complete apical lunule is the general condition, though a few specimens with a discontinuous one are present throughout the species range. Geographical patterns in these characteristics are not clearly discernible, though maculations of the elytra are broader and more frequently complete in specimens from northern Brazil. Specimens in southern Brazil tend to have discontinuous or absent portions of the elytral maculations. Specimens of *C. a. macella* Rivalier have elytral maculations much reduced. Whether or not they are the predominant form in well defined geographical populations remains to be seen. We follow recent authors in recognizing subspecies of non-Brazilian forms.

*Relationships*.— *Cicindela argentata* is sister to the lineage that gave rise to *C. venustula* Gory (northern S. America) and sister species *C. obscurella* and *C. pretiosa*.

*Habitat and Period of Activity*.— Label data indicate a period of activity from December to April. Adults live in moist open areas in grassy vegetation. They

occasionally occur along river beaches but usually near clumps of grass (Pearson, 1984).

*Geographical Distribution, Localities, Examined Specimens.*— Inland and near coasts, from northern Argentina, Uruguay to northern Brazil and French Guiana (Fig. 47), and Guadeloupe.

Argentina. *Cordoba*: no locality, 1M, MZSP. *Formosa*: Guaycolec, 2F, MZSP. *La Rioja*: Patquia, 1M, 1F, MZSP. *Tucuman*: no locality, 1M, 1F, MZSP.

Bolivia. Prov. del Sara\*, 6M, 9F, ICCM; Santa Cruz de la Sierra Bol., 1M, ICCM.

Brazil. *Amazonas*: Arima (on Rio Purus), 1M, ICCM; Beruri (on Rio Purus), 4M, 5F, MZSP; Canindé (50 km e), 4M, 3F, MZSP; Hyutanaham (on Rio Purus), 31M, 18F, ICCM; Itacoatiara (30 km w. on Rio Urubu), 2F, ICCM; Manaus, 3M, 4F, INPA; Manaus (Reserva Ducke, km 26 on Itacoatiara Hwy), 1M, BRI; Manaus (30 km ne), 3M, INPA; Manaus (40 km w. at Lago Janauaca), 1M, BRI; Manaus (60 km n), 1M INPA; Rio Cavaburi, 3F, MZSP; Rio Prêto, 1M, MZSP; Santo Antonio do Iga, 1F, MNRJ; São Gabriel, 1M 2F, IOC; Tapuruquara (on Rio Negro), 1F, MZSP; Tefé, 1F IOC. *Ceará*: Aracati, 1F, MZSP; IOC, 1M, 1F, MZSP; Jaquaribe, 1M, MZSP; Russas, 1M, 2F, MZSP. *Espirito Santo*: Guandu\*, 1M, 1F, IOC; no locality 1F, MNRJ. *Goiás*: Cabeceiras (Lagos Formosa), 1M, 2F, MZSP; Chapada, 6M, 6F, ICCM; Jatai, 17M, 6F, MZSP; Pirineus\*, 1F, MZSP; Vianópolis, 1F, MZSP. *Matto Grosso*: Barra do Tapirapé, 3M, 1F, MZSP; Bodoquena, !, IOC; Camisao\*, 1F, MZSP; Corumba, 1M, MZSP; Jacaré Pq. Nac. Xingu, 1M, MZSP; Murtinho\*, 1M, MZSP; Vacaria, 6M, 1F, MZSP; Salobra (Rio?), !, IOC; Três Lagoas, 1M, MZSP; Urucum, 1F, MZSP, 1M, MNRJ; Xingu, 1M, MZSP. *Minas Gerais*: Buritis, 1M, 1F, MZSP; Ipatinga, 1M, MZSP; Mar de Espanha\*, 1M, MNRJ; no locality, 1F, MZSP; Serra Caraca, 1F, MZSP. *Pará*: Cachimbo, !, IOC, 12!, MZSP; Oriximina, 2M, 2F, MZSP; Santarem, 7M, 5F, ICCM. *Paráíba*: Corema, 1M, MZSP. *Paraná*: Ponta Grossa, 1M, 1F, MZSP. *Santa Catarina*: Joinville, 1M, MZSP; Nova Teutonia, 2M, 1F, MZSP. *São Paulo*: Alto da Serra\*, 1M, MZSP, Avanhad (Garbe Lake)\*, 1M, MZSP; Barueri, 4M, 5F, MZSP; Boraceia\*, 1M, 3F, MZSP; Campos do Jordao, 1F, MZSP; Cantareira, 1F, MZSP; Caraquatuba, 1F, MZSP; Embu, 1F, MZSP; Estac, 1F, MZSP; Iporanga, 3F, MZSP; Itu, 2M, MZSP; Mairiporã, 1M, MZSP; 1M, MZSP; Onda Verde\*, !F, MZSP; Pindamonhangaba, 1M, 1F, MZSP. Pirassununga, 1M, MZSP; Rincao, 1M, MZSP; São Paulo, 2M, 2F, MZSP; Sapuchui, 1M, MZSP; Ypiranga, !, MZSP.

French Guiana. Oiapoque River, 3M, 5F, ICCM.

Paraguay. Asuncion, 2F, ICCM.

Peru. Huancayo, !, IOC; Rio Ampiacu\*, 1M, 1F, MZSP.

Uruguay. Paysandu (on Rio Uruguay), 1M, MNRJ.

(Note: Ecuador; *C. a. umbrogemata* Horn, 1906: 87.

Venezuela; *C. argentata* and *C. a. pallipes* Horn, 1903: 334.

### *Cicindela (Brasiella) obscurella* Klug

Figs. 2, 13, 24, 36, 37, 48

*Cicindela obscurella* Klug, 1829: 3 (TYPE LOCALITY, Süd-Brasilien). - Dejean, 1831: 268. - Horn, 1891: 324; 1906: 89; 1915: 407; 1926a: 308; 1938: 52. - Barattini, 1929: 1219. - Fernandez, 1936: 105. - Blackwelder, 1944: 17. - Rivalier, 1954: 263; 1955: 82. Vidal Sarmiento, 1966a: 256-257; 1966b: 32. Sumlin, 1979: 103.

*Cicindela tripunctata* Dejean, 1831: 267 (TYPE LOCALITY, les parties meridionales du Brésil). - Horn, 1915: 407; 1926a: 308. Blackwelder, 1944: 17. - Vidal Sarmiento, 1966b: 32.

*Cicindela celeripedestrís* Horn, 1896b: 357 (TYPE LOCALITY, Minas Geraes); 1938: 52. Blackwelder, 1944: 17. - Rivalier, 1955: 84. Vidal Sarmiento, 1966b: 32.

*Cicindela obscurella constricta* Rivalier, 1955: 83 (TYPE, a male in the MNHP general collection bearing the following labels: "Brésil (Minas) Sertao de Diamantina Faz Das Melancias E. Gounelle 10-11 1902/Muséum Paris Brésil coll. E. Gounelle 1913/ *B. obscurella* ssp. *constricta* mihi E. Rivalier det/TYPE" (black letters on red label)/ "penis 974 Rivalier"; TYPE LOCALITY, Minas Geraes). NEW SYNONYMY.

*Brasiella chrysocollis* Mandl, 1963: 585 (TYPE LOCALITY, Jacare P.N. Xingu, M. Grosso, Bras.). NEW COMBINATION AND SYNONYMY.

*Brasiliella pallidipes* Mandl, 1963: 589 (TYPE LOCALITY, Sta. Catarina, Brasil). NEW COMBINATION AND SYNONYMY.

*Recognition.*— The elongate and edentate labrum (Figs. 2a, b) combined with the almost effaced elytral maculations. (Figs. 24a, b) separates *C. obscurella* from other species of the *argentata* group. Adults of *C. obscurella* are generally larger than adults of its sister species *C. argentata*. Two dark finger-like brushes of setae in the bursa copulatrix of females also distinguish *C. obscurella* from other related species (Figs. 36d, 37d, e). In addition the shapes of sclerites in the internal sac of the median lobe of males characterize this species (Rivalier, 1955: 84).

*Synonyms and Types.*— Except for the holotype and allotype of *C. o. constricta* Rivalier, we have not seen the types of this complex. The names are based on comparison of original descriptions with specimens on loan.

In treating *C. celeripedestrus* Horn as a junior synonym we follow Horn (1938: 53) and Vidal Sarmiento (1966b: 32). We have examined specimens from Uruguay which conform to the description of *C. o. constricta* Rivalier. They do not appear to form a single geographical population. *Brasiliella chrysocollis* Mandl appears to be a coloured form of *C. o. constricta* Rivalier. We consider *Brasiliella pallidipes* Mandl to be a small form of *C. obscurella* in view of the fact that the labrum is edentate and that it is found within the range of *C. obscurella*.

*Description.*—

*Body length.* 8.0 mm M, 8.5 mm F.

*Body colour.* Head and pronotum slightly glossy, black with coppery reflections; elytra dull, black with coppery reflections, some specimens with green, blue or purple reflections. Venter glossy, black with green, blue, purple and coppery reflections; pleuron mainly coppery, green and blue.

*Body setae.* Pronotum and proepisternum sparsely setose, mesepisternum with a few setae at ventral end, metepisternum more densely setose; abdominal sterna one to six setose mainly on lateral margins.

*Other external features.* Labrum elongate edentate, median portion almost tooth-like in some females, with eight submarginal setae, ranging in number from six to 10 (Figs. 2a, b). Pronotum narrow, sutures shallow (Figs. 13a, b). Coupling sulcus of mesepisternum of female a long and sinuate groove. Apex of front trochanters with one sensory seta, middle of trochanters glabrous. Elytra with recurved apices; maculations discontinuous or almost effaced; punctures large, shallow, with green (mainly) and coppery reflections (Figs. 24a, b); a few erect setae present near shoulder; microsculpture isodiametric, bead-like; apical microserrulations very small, almost obsolete.

*Female genitalia.* Sternum 8 with wide V-shaped shallow emargination in apical end; apices broadly rounded, each with a group of four short stout setae (Fig. 36a). Second gonocoxa with setae along medial margin (Fig. 36a). Second gonapophyses with medial portion 2/3 length of lateral portion (Fig. 36a). Syntergum 9 and 10 rectangular (Fig. 36b). Ventral sclerite strongly sclerotized, median ridge well developed with two finger-like brushes on inside of bursa (Figs. 36c, d, 37c-e). Membrane in place of oviduct sclerite (Figs. 36c, 37c). Spermatheca and duct *ca* 1.5 mm.

*Male genitalia.* Male genitalia have been described by Rivalier (1955: 84).

*Geographical Variation.*— Within populations, the elytral maculations, especially the middle band, vary from diffuse to almost effaced (Figs. 24a, b). A few adults with almost complete middle bands are present in São Paulo and can be confused with *C. argentata* adults.

*Relationships.*— *Cicindela obscurella* and *C. pretiosa* are sister species.

*Habitat and Period of Activity.*— Adults have been collected in December in Brazil, and in February in Argentina, Paraguay and Uruguay. Habitat unknown.

*Geographical Distribution, Localities, Examined Specimens.*— Inland northern Argentina, Bolivia, Paraguay and Uruguay to south Brazil (Fig. 48).

Argentina. *Salta*: San Lorenzo\*, 1M, 1F, MNRJ. *Tucuman*: no locality, 1M, 2F, IOC.

Brazil. no locality, 1F, BMNH, 1F, USNM. *Minas Gerais*: Pocos de Caldas, 6F, RRMCM. *Santa Catarina*: Nova Teutonia, 6!, RRMCM. *São Paulo*: Campos do Jordao, 3M, 10F, MZSP.

Paraguay. Loma\*, 1F, IOC; no locality, 2M, 1F, IOC, Puerto Bertoni\*, 1M, 1F, IOC, Villarrica, 1M, IOC.

Uruguay. Maldonado, 1M, MNRJ; Montevideo, 4F, CASC, 1M, MNRJ, 4M, 7F, 1!, USNM; Rocha, 1M, MNRJ; Tacuarembó, 1F, MNRJ.

*Cicindela (Brasiella) pretiosa* Dokhtouroff

Figs. 3, 14, 25, 38, 48

*Cicindela pretiosa* Dokhtouroff, 1882: 276 (TYPE LOCALITY, l'Amazone). Horn, 1915: 407; 1926a, 309; 1938: 52. Blackwelder, 1944: 19. Rivalier, 1954: 263; 1955: 97.

*Recognition.*— The protruded central portion of the front margin of the labrum (Figs. 3a-c) together with pattern of elytral maculations distinguish adults of *C. pretiosa* from those of all other South American tiger beetles.

*Synonyms and Types.*— We have not seen the type specimen of *C. pretiosa*. The name is based on comparison of specimens on loan with the original description and the drawings of the elytra by Horn (1938: 52) and Rivalier (1955: 97).

*Description.*—

*Body length.* 7.0 mm M, 9.0 mm F.

*Body colour.* Head and pronotum slightly glossy, dark brown to black with coppery reflections; elytra dull, dark brown with coppery reflections. Venter black with blue, green, and coppery reflections.

*Body setae.* Pronotum with front and lateral margin moderately setose, and a few setae medially; proepisternum and mesepisternum with a few setae near ventral margin; metepisternum moderately setose throughout; metasternum and abdominal sterna setose laterally.

*Other external features.* Labrum edentate (or obsoletely tridentate), with front margin broadly protruding in center (Figs. 3a-c), and eight to 10 submarginal setae. Pronotum broader anteriorly (Figs. 14a-c). Coupling sulcus of mesepisternum of female a deep sinuate groove. Elytra apices slightly recurved with small apical spine; humeral lunule represented by a small subapical spot, with a small humeral spot present in some specimens, middle band short, sinuate and broad, and apical lunule reduced (Figs. 25a-c); punctuation broad, shallow with green and coppery reflections; microsculpture isodiametric, bead-like.

*Female genitalia.* Sternum 8 with broad V-shaped posterior emargination, apices each with a group of three stout setae (Fig. 38a). Second gonocoxa with medial setae. Second gonapophyses with medial portion 0.75 length of lateral portion (Fig. 38a). Syntergum 9 and 10 as in Figure 38b. Ventral sclerite broad, slightly sclerotized, with two apical setiferous brushes; median ridge absent. Membrane in place of oviduct sclerite (Fig. 38c). Spermatheca and duct ca 1.5 mm in length.

*Male genitalia.* Unknown.

*Geographical Variation.*— The pattern of the elytral maculations varies, particularly in the shape of the middle band and the presence or absence of the humeral and subhumeral spots (Figs. 25a-c).

*Relationships.*— *Cicindela pretiosa* and *C. obscurella* are sister species.

*Habitat and Period of Activity.*— Adults have been collected in January and February. Habitat unknown.

*Geographical Distribution, Localities, Examined Specimens.*—

Amazon Basin (Fig. 48).

Brazil. *Amazonas*: Itacoatiara (km 244), 1M, INPA; Manaus (1 km w. Taruma Falls), 1M, 1F, ICCM; Manaus (30 km. n.), 1M, INPA; Manaus (60 km n.), 2M, 1F, INPA; Manaus (Reserva Ducke), 2M, 1F, INPA.

### *The aureola group*

Adults of this group are characterized by bright coppery with some green on the head, pronotum and elytra, and unpigmented bell-shaped spot in abdominal sternum 5 and setae present in the bursa copulatrix of the female. The group has four species, two of which are found in Brazil, *C. amaenula* and *C. aureola*. The geographical range of the *aureola* group extends from northern Argentina northward to Venezuela. This group is a distant relative of the *argentata*, *hemichrysea* and *viridicollis* groups.

### *Cicindela (Brasiella) amaenula* Chaudoir

Figs. 4, 15, 26, 39, 49

*Cicindela amaenula* Chaudoir, 1854: 120 (TYPE LOCALITY, les rives du fleuve des Amazones). - Horn 1906: 88; 1915: 407; 1923: 112; 1926a: 308; 1938: 52. Blackwelder, 1944: 17. - Rivalier, 1954: 263; 1955: 89. Mandl, 1963: 588, 591.

*Recognition.*— Specimens of *C. amaenula* are characterized by their very broad elytral maculations (Fig. 26). As Rivalier (1955: 90) observed some *C. amaenula* specimens have narrow maculations and may be confused with *C. argentata* specimens, but the former are distinguished by their more obliquely directed middle band (Fig. 2 cf Fig. 23a) combined with poorly developed marginal teeth of the labrum (Fig. 4). Female genitalia (Fig. 39) and male genitalia (Rivalier, 1954: 262; 1955: 90) are also specifically distinct.

*Synonyms and Types.*— The name *C. amaenula* is based on comparisons of the original description with specimens on loan.

#### *Description.*—

*Body length.* 8.0 mm F.

*Body colour.* Head and pronotum slightly glossy brown to black with green and coppery reflections; elytra slightly glossy brown with coppery reflections. Venter glossy, black with coppery green and blue reflections; pleura with mainly coppery and green reflections.

*Body setae.* Pronotum moderately setose, proepisternum sparsely setose; mesepisternum with a few setae at ventral end; metepisternum more densely setose; metasternum setose laterally; abdominal sterna 1-6 setose, more densely so on lateral margin.

*Other external features.* Labrum obsoletely tridentate with eight submarginal setae (Fig. 4). Posterior end of pronotum narrow (Fig. 15). Coupling sulcus of mesepisternum of female a long sinuate moderately deep groove. Apices of front trochanters with one seta. Elytra of female with slightly recurved apices, apical spine not well developed; humeral lunule reduced to shoulder and apical spots, middle band, marginal band and apical lunule well developed and broad (Figs. 26); punctation broad, shallow and with green (mainly) and coppery reflections.

*Female genitalia.* Sternum 8 with shallow broad V-shaped posterior emargination; apices broadly rounded each with a group of four stout setae (Fig. 39a). Second gonocoxa moderately setose near medial margin (Fig. 39a). Second gonapophyses with medial portion 0.75 length of lateral portion (Fig. 39a). Syntergum 9 and 10 as in Figure 39b. Ventral sclerite broadly apically, very narrow basally; median ridge absent. Membrane in place of oviduct sclerite (Fig. 39c). Spermatheca and duct ca 1.0 mm in length.

*Male genitalia.* Male genitalia have been described by Rivalier (1954: 262; 1955: 90).

*Geographical Variation.*— Even though considerable variation is evident in the pattern of the elytral maculations (Rivalier, 1955: 90) they are broad in most specimens. A geographical pattern could not be discerned as too few specimens were available for examination. Specimens examined from Matto Grosso were typically brown with coppery reflections, although a single green specimen was seen.

*Relationships.*— *C. amaenula* is sister to the lineage that gave rise to sister species *C. aureola* and *C. horioni* Mandl (Bolivia).

*Habitat and Period of Activity.*— Adults have been collected in November; they are probably riparian.

*Geographical Distribution, Localities, Examined Specimens.*— Inland, ranging from Matto Grosso north to the Amazon River (Fig. 49).

Bolivia. Prov. de Sara\*, 1F, ICCM.

Brazil. *Amazonas*: Amazon River, 1F, BMNH, 2M, MZSP. *Goiás*: Chapada, 4M, 4F, ICCM. *Matto Grosso*: Corumba, 6M, 1F, MZSP; Cuyaba, 1M, RRM, São Luiz de Cáceres, 3M, 2F, IOC, 1M, MNRJ.

### *Cicindela (Brasiella) aureola* Klug

Figs. 5, 16, 27, 40, 41, 49

*Cicindela aureola aureola* Klug, 1834: 35 (TYPE LOCALITY, sudlichen Brasilien). Horn, 1906: 88; 1915: 407; 1926a: 308; 1938: 52. Varas Arangua, 1925: 37. Blackwelder, 1944: 17. Rivalier, 1954: 263; 1955: 89. Vidal Sarmiento, 1966b: 34. Sumlin, 1979: 103.

*Cicindela alboguttata* Audouin and Brullé, 1839: 137 (not Klug) (TYPE LOCALITY, Brésil. Province de Campos-Geraes). Horn, 1896a: 353; 1915: 407; 1926a: 308. Blackwelder, 1944: 17. Vidal Sarmiento, 1966b: 34.

*Cicindela argyrosticta* Gemminger and Harold, 1868: 9 (replacement name for *C. alboguttata* Audouin and Brullé). Horn, 1892b: 213; 1915: 407; 1926a: 308. Blackwelder, 1944: 17. Vidal Sarmiento, 1966b: 34.

*Cicindela cyanitarsis* Kollar, 1836: 332 (TYPE LOCALITY, in Brasiliae provincia Ypanema). Horn, 1891: 324; 1892a: 95; 1915: 407; 1926a: 308; 1938: 52. Blackwelder, 1944: 17. Rivalier, 1955: 91. Mandl, 1960: 279; 1963: 587. Vidal Sarmiento, 1966b: 34.

*Cicindela aureola jatahyana* Rivalier, 1955: 91 (TYPE, a male in the MNHP general collection bearing the following label: "Jatahy État de Goyas ch. Pujol 1895-96/ Muséum Paris 1952 coll. R. Oberthür/penis 945 Rivalier/B. aureola s.sp. jatahyana mihi Rivalier det./ TYPE" (black letters on red label); TYPE LOCALITY, Jatahy (état de Goyaz)). Mandl, 1963: 587. Vidal Sarmiento, 1966b: 34.

*Brasiella aureola alvarengai* Mandl, 1963: 586 (TYPE LOCALITY, Jacaré P.N. Xingu, M. Grosso, Bras.).

*Recognition.*— The combination of edentate labrum (Figs. 5a, b), bright or dark red coppery or brown dorsum with green reflections, and reduced pattern of elytral maculations (Fig. 27) characterize *C. aureola*. Female genitalia (Figs. 40, 41) and male genitalia (Rivalier, 1954: 263; 1955: 90) also distinguish this species.

*Synonyms and Types.*— The names of the taxa in this complex are based on comparison of original descriptions with examined specimens and examination of the type of *C. aureola jatahyana* Rivalier. We follow Horn (1938: 52, Pl. 85) in treating *C. cyanitarsis* as a morph of *C. a. aureola* distinguished by a defined middle band. Members of *C. aureola jatahyana* Rivalier resemble the *C. cyanitarsis* form, with green punctuation on the dorsum, which is the prevalent condition in *C. aureola*. *Cicindela aureola alvarengai* Mandl is a dark coppery-brown-red form of *C.*



*aureola* with a slender middle band.

*Description.*—

*Body length.* 8.5 mm M, 8.5-9.0 mm. F.

*Body colour.* Head and pronotum slightly glossy, elytra dull, almost matte. Dorsum brown with bright red-coppery (mainly) and green reflections, some specimens with dark dorsum or pronotum darker than elytra. Venter glossy with coppery, green, and blue reflections.

*Body setae.* Pleuron sparsely to moderately setose; mesepisternum with a few setae on ventral end only; metasternum setose laterally; abdominal sterna 1-6 setose mainly on lateral margins.

*Other external features.* Labrum edentate, middle portion protrudes in female with eight submarginal setae (Figs. 5a, b). Coupling sulcus of mesepisternum of female in form of sinuate groove. Apex of front trochanters each with one sensory seta, middle trochanters glabrous. Elytra with slight apical sinuation and apex recurved; apical spine small; maculations reduced, with one humeral spot, middle band, and subapical spot, or almost effaced (Fig. 27); punctures very shallow with green reflections; microsculpture isodiametric and bead-like. Pronotum as in Figure 16.

*Female genitalia.* Sternum 8 with wide and very shallow V-shaped posterior emargination; each apex with three very thick setae (Figs. 40a, 41a). Second gonocoxa with several setae on medial margin (Figs. 40a, 41a). Medial portion of second gonapophyses as long as or almost as long as lateral portion (Figs. 40a, 41a). Syntergum 9 and 10 as in Figures 40b, 41b. Ventral sclerite of bursa with posterior end emarginated and curved dorsally, setae present on lateral margins, median ridge absent (Figs. 40c, d, 41c, d). Membrane in place of oviduct sclerite (Figs. 40c, 41c). Length of spermatheca and duct unknown (lost in dissection).

*Male genitalia.* Male genitalia have been described by Rivalier (1954: 263; 1955: 90).

*Geographical Variation and Subspecies.*— Specimens with discontinuous or almost effaced maculations on the elytra seem to be predominant in the southern populations of Paraguay. Darker specimens appear to be more common in the populations of Matto Grosso, Brazil. Firm application of subspecific names (see Synonyms and Types section) will depend on whether these characteristics are clinal in nature or mark geographically distinct populations. Nonetheless the subspecific names *C. a. jatahyana* Rivalier and *C. a. alvarengai* Mandl are probably valid, representing populations in the northern parts of the species range and Matto Grosso respectively.

*Relationships.*— *Cicindela aureola* and *C. horioni* are sister species.

*Habitat and Period of Activity.*— Specimens have been captured in December in Matto Grosso. Habitat unknown.

*Geographical Distribution, Localities, Examined Specimens.*— Mainly inland, southern Brazil (Fig. 49).

Brazil. *Amazonas*: Manaus, 2F, MZSP. *Matto Grosso*: Vacaria, 5M, 3F, MZSP. *São Paulo*: São Paulo, 1F, BMNH, 1M, MZSP.

Paraguay. no locality, 1F, MZSP.

### The *misella* group

Adults of this group are characterized by a broad and shallow apical emargination in abdominal sternum 8 and narrow oviduct sclerite in the female, and one or two sagittal sclerotized plates in the internal sac of the male. The group has five species, of which two are found in Brazil, *C. dolosula* and *C. misella*. The geographical range of the *misella* group extends northward from northern Argentina to Venezuela and Guatemala, and is centered in southeastern Brazil and eastern

Paraguay. The *misella* group is a distant relative of the *aureola*, *argentata*, *hemichrysea* and *viridicollis* groups.

*Cicindela (Brasiella) dolosula* Rivalier

Figs. 6, 17, 28, 50

*Brasiella dolosula* Rivalier, 1955: 95 (TYPE, a male in the MNHP general collection bearing the following labels: "1114 86" (label green on one side)/ "Salobro prov. de Bahia L. Gounelle 6.7.1885"/(extracted male genitalia)/"*B. dolosula* (type) mihi E. Rivalier det./ Muséum Paris Gounelle 1114-86/TYPE" (Black letters on red label); TYPE LOCALITY, Salobro, province de Bahia).

**Recognition.**— Specimens of *C. argentata* and *C. dolosula* are nearly identical except for striking differences in the internal sac of the male genitalia (female genitalia are unknown). Most specimens of *C. dolosula* are distinguished as follows: pronotum with sides feebly convex (less convex than that of *C. argentata* specimens); humeral spot almost always absent and the subhumeral spot tiny and scarcely visible; male genitalia resemble that of *C. misella* (Rivalier, 1955: 95). See also Recognition section of *C. misella*.

**Description.**—

*Body length.* 7.0 - 7.5 M, female unknown.

*Body colour.* Head and pronotum dull to slightly glossy with coppery tint; elytra dull, coppery brown with green punctuation; pleuron coppery-green; venter with green, blue, coppery reflections.

*Body setae.* Pronotum sparsely setose on lateral and front margins and a few setae on front central portions; pleuron, and lateral portions of abdominal sterna 1-6 moderately setose; mesepisternum with a few ventral setae.

*Other external features.* Labrum slightly projected in front, tridentate, with eight submarginal setae (this number varies from six to 10) (Fig. 6). Pronotum elongate, sides feebly convex, sutures shallow (Fig. 17). Apex of front trochanters with one sensory seta. Elytra obliquely rounded behind, slightly recurved to small apical spine. Humeral spot absent from shoulder (or almost absent), subhumeral spot very tiny, almost effaced; marginal band short, middle band and apical lunule complete; punctures large, shallow, with green reflections (Fig. 28); fine erect setae present near shoulder.

*Genitalia.* Female specimens have not been examined. Male genitalia have been described by Rivalier (1955: 95).

**Geographical Variation.**— The following notes on variation are based on observations by Rivalier (1955: 95-97). The number of submarginal setae on the labrum is mainly 8 but varies from 6-10; and the humeral spot on the shoulder of the elytra is almost always absent. No geographical pattern in the variation of these characteristics has been found.

**Relationships.**— *Cicindela dolosula* and *C. misella* are sister species.

**Habitat and Period of Activity.**— Adults have been collected in November. Habitat unknown.

**Geographical Distribution, Localities, Examined Specimens.**— Widespread inland, from the eastern Brazilian highlands and northern Argentina to northwestern Brazil and the Canal Zone (Fig. 50).

Argentina. *Formosa*: Guaycolec, 1F, MZSP. *Jujuy*: Dique La Dienaga, 3M, 5F, MZSP.

Brazil. *Bahia*: Salobro\* (type), 1M, MNHP. *Espirito Santo*: Linhares, 3M, 3F, RRM; Rio Itabapoana, 1M, MZSP. *Goiás*: Chapada, 2M, ICCM; Deodoro (Federal District), 1M, MZSP; Dianopolis, 6M, 3F, MZSP. *Matto Grosso*: Barra do Tapirapé, 1F, MZSP; Três Lagoas, 1M, MZSP; Xingu, 1M, MZSP. *Minas Gerais*: Unai, 1M, MZSP. *Pará*: Cachimbo, 16!, MZSP. *Roraima*: Rio Mucajai south of Boa Vista, 1M,

MZSP. *Rio de Janeiro*: Campos, 1M, RRMC; no locality, 1M, 2F, ICCM. *São Paulo*: Barueri, 2M, 1F, MZSP; Campos do Jordao, 8M, 8F, MZSP; Estrada Rio\*, (km 47), 1M, 1F, MZSP; Ilha da Vitoria\*, 1F, MZSP; Itu, 2M, 3F, MZSP; Nova Europa\*, 1F, MZSP.

*Cicindela (Brasiella) misella* Chaudoir

Figs. 7, 18, 29, 42, 50

*Cicindela misella misella* Chaudoir, 1854: 121 (TYPE, a female in MNHP general collection bearing the following label: "Columbie/misella Chaud./ Muséum Paris type de Chaudoir ex collection Chaudoir/TYPE" (black letters on red label); TYPE LOCALITY, la Columbie). Bates, 1881: 14. Horn 1915: 406; 1926a: 308. Blackwelder, 1944: 17. Rivalier, 1954: 263; 1955: 93. Vidal Sarmiento, 1966b: 34. Sumlin, 1979: 104.

*Cicindela misella transversalis* Rivalier, 1955: 95 (TYPE, a male in the MNHP general collection bearing the following labels: "Guatemala" (green label) / "Muséum Paris ex. coll. M. Maindron coll. G. Babault 1930/penis 924 Rivalier/misella m. transversalis mihi type E. Rivalier det."; TYPE LOCALITY, Guatemala).

**Recognition.**— A tridentate labrum with a non-protruding front margin (Figs. 7a, b), and small humeral spot hidden from dorsal view but present on the latero-ventral side of the elytral shoulder together distinguish adults of *C. misella* from those of *C. argentata* and *C. dolosula*. Because these characteristics vary, a decisive identification can only be made on the basis of the male genitalia.

**Description.**—

*Body length.* ca 6.5 mm M and F.

*Body colour.* Head and pronotum slightly glossy black with green and coppery reflections, elytra dull, dark brown, pleuron and venter glossy to slightly glossy black with coppery, green, and blue reflections.

*Body setae.* Head glabrous. Pleuron setose, mesepisternum with a few setae near ventral end. Lateral (mainly) portions of abdominal sterna 1-6 (M,F) with appressed setae.

*Other external features.* Labrum narrow, tridentate, with lateral teeth broadly rounded, with basically eight (five to eight) submarginal setae (Figs. 7a, b). Pronotum narrow, broadened anteriorly (Figs. 18a, b). Coupling sulcus of mesepisternum of female with deep elongate central pit. Apex of front trochanters with one seta. Elytra with apex not recurved in males, slightly recurved in females, small apical spine (Figs. 29a, b). Pattern of elytral maculations with small humeral spot hidden on the lateroventral side of shoulder, large subhumeral spot, broadened complete middle band and apical lunule, marginal band short (Figs. 29a, b). Punctuation of elytra green.

*Female genitalia.* Sternum 8 with shallow, very broad apical emargination, apices with four or five stout setae (Fig. 42a). Second gonocoxa and second gonapophyses as in Figure 42a. Syntergum 9 and 10 broadened apically (Fig. 42b). Ventral sclerite flat, elongate, lightly sclerotized (Fig. 42c). Oviduct sclerite narrow (Fig. 42c). Spermatheca and duct ca 1.0 mm long.

*Male genitalia.* Described and figured by Rivalier (1954: 263; 1955: 93-95) and Vidal Sarmiento (1966b: 34).

**Geographical Variation.**— Maculations of the elytra vary but a geographical pattern is not evident. Adults of Rivalier's *C. misella transversalis* from Guatemala have a distinct transverse middle band.

**Relationships.**— *Cicindela misella* and *C. dolosula* are sister species.

**Habitat and Period of Activity.**— Adults have been collected in March. Habitat unknown.

**Geographical Distribution, Localities, Examined Specimens.**— Central America and northwestern South America (probably east of the Andes) south to southwestern Brazil and Argentina (Fig. 50).

Bolivia. Chiquitos\* (300 m), 4M, 1F, ICCM.  
 Brazil. *Matto Grosso*. Corumba, 1M, ICCM.  
 Colombia. Bugaba (or Buga) (800-1500'), 2M, 2F, BMNH.  
 Canal Zone. Barro Colorado, 1F, MZSP.

#### The *minarum* group

Adults of this group are characterized by a median ridge on the ventral sclerite of the bursa copulatrix of the female, and a short tooth and absence of small stiffening rib in the internal sac of the male. The group has eight species four of which are found in Brazil, *C. hamulipenis*, *C. brevipalpis*, *C. banghaasi*, and *C. minarum*. The geographical range of the *minarum* group extends from the Brazilian Highlands northward to Venezuela and southern Mexico. The *minarum* group is not closely related to any other group in subgenus *Brasiella*.

#### *Cicindela (Brasiella) hamulipenis* Horn

Figs. 8, 19, 30, 45, 51

*Cicindela hamulipenis* Horn, 1938: 14, 52, Pl. 85, Fig. 1 (HOLOTYPE, a male, in the IPZE collection bearing the following label: "Goyas/Type W. Horn/Holotypus" (black letters on red label); TYPE LOCALITY, Goyas (Brasilia center.)) - Blackwelder, 1944: 18.

**Recognition.**— The combination of protruding unidentate labrum with six or seven submarginal setae (Fig. 8), reduced pattern of the elytral maculations (Fig. 30), and small body size characterizes this species. The apical end of the median lobe is broad (Fig. 45a, b) and the internal sac contains sclerites with specific shapes (Fig. 45d).

##### **Description.**—

*Body length.* 6.0 mm M.

*Body colour.* Head pronotum and elytra dull, dark brown, with coppery (especially the pronotum) and green reflections. Pleuron with coppery and green reflections. Venter with green and blue-green reflections.

*Body setae.* Lateral margins of pronotum and pleuron moderately setose, mesepisternum of male mainly glabrous except for the ventral end. Abdominal sterna 1-6 setose, mainly on lateral margins.

*Other external features.* Labrum convex and elongate, unidentate, with five to seven submarginal setae (Fig. 8). Pronotum widest in anterior 0.5 (Fig. 19). Apex of front trochanters with one seta. Apices of elytra recurved to very small spine; maculations largely effaced showing remains of subapical humeral spot, middle band and apical lunule (Fig. 30); punctures of elytra shallow and green, a few larger punctures are present along median suture and on shoulder; microsculpture isodiametric and bead-like.

*Female genitalia.* Females were not available for examination.

*Male genitalia.* The median lobe is like that of other species in *Brasiella* but broader in the apical end (Figs. 45a, b); sclerites of the internal sac are specific for *C. hamulipenis*. Shield bifid apically. Stylet and arciform piece elongate, slender. Tooth slender, apex pointed. Right bar absent. Flagellum lacking (Fig. 45d).

**Relationships.**— *Cicindela hamulipenis* and *C. brevipalpis* are sister species.

**Habitat and Period of Activity.**— Adults have been collected in January. Habitat unknown.

**Geographical Distribution, Localities, Examined Specimens.**— Only the Holotype (IPZE) and one other male were examined. Both specimens were collected

in Goiás, the non-Holotype in Dianópolis, 11-14.1.1962 (Fig. 51).

Brazil. Goiás: Dianópolis, 1M, MZSP; no locality, 1M IPZE.

*Cicindela (Brasiella) brevipalpis* Horn

Figs. 9, 20, 31, 46, 51

*Cicindela brevipalpis* Horn, 1926b: 77 (TYPE LOCALITY, Vacarias von Sud-Matto Grosso); 1926a: 308; 1938: 52. Blackwelder, 1944: 17.

*Recognition.*— The character state of small body size, *ca* 6.0 mm long, elytra that lack both a distinct shoulder at the anterior end and maculations (Fig. 31), and an indistinct 5-dentate labrum and 6 submarginal setae (Fig. 9) taken together are diagnostic for adults of *C. brevipalpis*.

*Synonyms and Types.*— The name *C. brevipalpis* Horn is based on comparison of the original description with a male specimen on loan from IPZE labelled: “Matto Grosso Vacaria XII-22/Type W. Horn/Syntypes” (black letters on a red label).

*Description.*—

*Body length.* *ca* 6.0 mm M.

*Body colour.* Body dull, black, with some coppery and green reflections on the head, thorax and elytra.

*Body setae.* Pronotum with a few setae on lateral margins and central disc. Pleuron and lateral portions of the metasternum with appressed setae, only the ventral end of the mesepisternum setose; abdominal sterna 3-6 inclusive sparsely setose.

*Other external features.* Head with protruding eyes. Labrum indistinctly five dentate, six submarginal setae, with the middle four close to the margin (Fig. 9). Pronotum narrow, broader at the anterior end (Fig. 20). Tibia rufotestaceous. Apex of front trochanters with one sensory seta, middle trochanters glabrous. Elytra lacking distinct shoulder, apices not recurved, apical spine well developed; maculations absent; punctures very shallow and marked with green (mainly) and coppery spots (Fig. 31); microsculpture isodiametric, bead-like. Flight wings absent.

*Female genitalia.* Females were not available for dissection.

*Male genitalia.* Apex of median lobe with short protruding tip; not hooked. Internal sac with at least one apical setal brush. Flagellum lacking. Sclerites of internal sac very well sclerotized; the shield bears two sharp apices, arciform piece long and strongly oblique, stylet obliquely truncated at apex, tooth of moderate size and very thin in the apical 0.5 (Figs. 46a-c).

*Relationships.*— *Cicindela brevipalpis* and *C. hamulipenis* are sister species.

*Habitat and Period of Activity.*— The syntypes were found running quickly between grass in sparse grasslands in December 1922 (Horn, 1926b: 78).

*Geographical Distribution, Localities, Examined Specimens.*— The syntypes, collected in Vacaria, Matto Grosso (Fig. 51), are the only known specimens.

Brazil. Matto Grosso: Vacaria, 1M, IPZE.

*Cicindela (Brasiella) banghaasi* Horn

Figs. 10, 21, 32, 43, 51

*Cicindela banghaasi* Horn, 1907: 24 (TYPE LOCALITY, Cuyaba, Matto-Grosso); 1915: 408; 1923: 112; 1926a: 310; 1938: 53. Blackwelder, 1944: 17. Rivalier, 1954: 263; 1955: 98.

*Recognition.*— The character state combination of the sparsely setose frons and gena, unidentate labrum with 8 setae, pattern of elytral maculations with a broad oblique middle band (Fig. 32), round pit-like coupling sulcus of the mesepisternum

of the female, and structure of female genitalia (Figs. 43a-c) distinguishes *C. banghaasi* from other Brazilian species of *Cicindela*. Also structures of the internal sac of the male are specific (Rivalier, 1955:98).

*Synonyms and Types*.— The name *C. banghaasi* is based upon comparison of the original description with six syntypes, one female and five males, on loan from the IPZE, each labelled as follows: “Staudinger Cuyaba Matt. Gr./ Type! Dr. W. Horn/Syntypes”; and with one large group label “*Cicindela Banghaasi* H.6”.

*Description*.—

*Body length*. 6.5-7.0 mm M, 7.5 mm F.

*Body colour*. Dorsum dull; head and pronotum black or very dark brown with some coppery and green reflections; elytra very dark brown with coppery reflections and large green puncture spots. Pleuron coppery (mainly), blue and green. Venter black with blue-green (mainly) and some coppery reflections.

*Body setae*. Head with a few setae between the eyes, on the frons, clypeus in some specimens, and genae. Pronotum and pleuron moderately setose. All abdominal sterna setose, more densely so laterally.

*Other external features*. Labrum unidentate to tridentate (indistinct) with eight submarginal setae (Fig. 10). Pronotum broader anteriorly (Fig. 21). Coupling sulcus of mesepisternum of female a deep round pit. Apex of front trochanters with one sensory seta. Elytra with recurved apex to very small spine; humeral spot and subhumeral spot small, marginal band and apical lunule broad, middle band broad and oblique; punctation green, with a row of much larger green umbilicate punctures along with the median sutures, and some intermediate in size clustered near the shoulder (Fig. 32); a few erect setae present near shoulder; apical microsculptulations very small.

*Female genitalia*. Sternum 8 with wide V-shaped emargination in apical end, apices each with three stout setae and two smaller setae (Fig. 43a). Second gonocoxa with a few setae near apical end of medial margin; and second gonapophyses as shown in Figure 43a. Syntergum 9 and 10 as shown in Figure 43b. Ventral sclerite with a round darkened basal end and central broad median ridge well developed (Fig. 43c). Membrane in place of oviduct sclerite (Fig. 43c). Spermatheca and duct (broken in dissection), short, approximately 1.0 mm.

*Male genitalia*. Male genitalia have been described by Rivalier (1955: 98).

*Relationships*.— *C. banghaasi* is sister to the lineage that gave rise to sister species *C. hamulipenis* and *C. brevipalpis*.

*Habitat and period of activity*.— Unknown.

*Geographical Distribution, Localities, Examined Specimens*.—

Cuyaba, Matto Grosso (Fig. 51).

Brazil. *Matto Grosso*: Cuyaba, 1F, 5M, IPZE, 1F, RRM.C.

*Cicindela (Brasiella) minarum* Putzeys

Figs. 11, 22, 33, 44, 51

*Cicindela minarum* Putzeys, 1845: 369 (TYPE LOCALITY, Brésil. Province des Mines.). Horn, 1915: 406; 1926a: 307; 1938: 52. Blackwelder, 1944: 18. Rivalier, 1954: 263; 1955: 92,98,99.

*Recognition*.— The character combination of the short unidentate labrum with 7-12 submarginal setae (Figs. 11a, b), oblique truncation of the apical end of the elytra and colour pattern of elytral maculations (Figs. 33a, b) distinguishes *C. minarum* from other species of *Cicindela*.

*Description*.—

*Body length*. ca 8.0 mm M, ca 8.5 mm F.

*Body colour*. Dorsum dull, black with copper and green reflections. Pleuron copper (mainly) and some green. Venter black with mainly blue and purple reflections.

*Body setae.* Pronotum with a few setae along lateral margin and middle suture. Proepisternum and mesepisternum with a few sparse setae mainly in ventral 0.5; other pleural sclerites, the lateral 0.5 of the metasternum and abdominal sterna 1-6, moderately setose.

*Other external features.* Labrum short and unidentate, almost tridentate, with seven (M) to 12 (F) submarginal setae (Figs. 11a, b). Pronotum square-shaped with parallel sides. Coupling sulcus of mesepisternum of female a deep groove with a pit in the center. Apex of front trochanters with one seta. Apical end of elytra obliquely truncated and recurved to small apical spine (Figs. 33a, b). Pattern of elytral maculations reduced with subapical spot present or absent, marginal band short, discontinuous sinuate middle band, and complete apical lunule with recurved hook-shape at distal end (Figs. 33a, b). Punctuation large, shallow, blue and green, and sparsely distributed. Microsculpture isodiametric, bead-like.

*Female genitalia.* Sternum 8 with broad V-shaped apical emargination, apices each with a group of three stout setae (Fig. 44a). Second gonocoxa with several setae on medial margin (Fig. 44a). Gonapophyses short, stout (Fig. 44a). Syntergum 9 and 10 as in Figure 44b. Ventral sclerite darkly sclerotized; median ridge well developed (Fig. 44c). Membrane in place of oviduct sclerite (Fig. 44c). Spermatheca and duct length unknown (broken in dissection).

*Male genitalia.* Male genitalia have been described by Rivalier (1955: 99).

*Relationships.*— *Cicindela minarum* is sister to the lineage that gave rise to *C. nebulosa* Bates (Nicaragua to Colombia and Ecuador) and sister species *C. mandli* Brouerius van Nidek (Chiapas, Mexico) and *C. insularis* Brouerius van Nidek (Trinidad).

*Habitat and Period of Activity.*— Specimens of *C. minarum* have been collected in December and April. Habitat unknown.

*Geographical Distribution, Localities, Examined Specimens.*— Geographical distribution mainly inland in southern Brazil (Fig. 51).

Brazil. *Espirito Santo*: no locality, 1F, IOC, 1M, MZSP. *Matto Grosso*: Vacaria, 1 2F, MZSP. *Minas Gerais*: Mar de Espanha\*, 1M, 1F, IOC, 1M, 1F, MZSP, 1F, RRM; Passa Quatro, 1M, 1F, IOC.

#### Subgenus *Gaymara* new subgenus

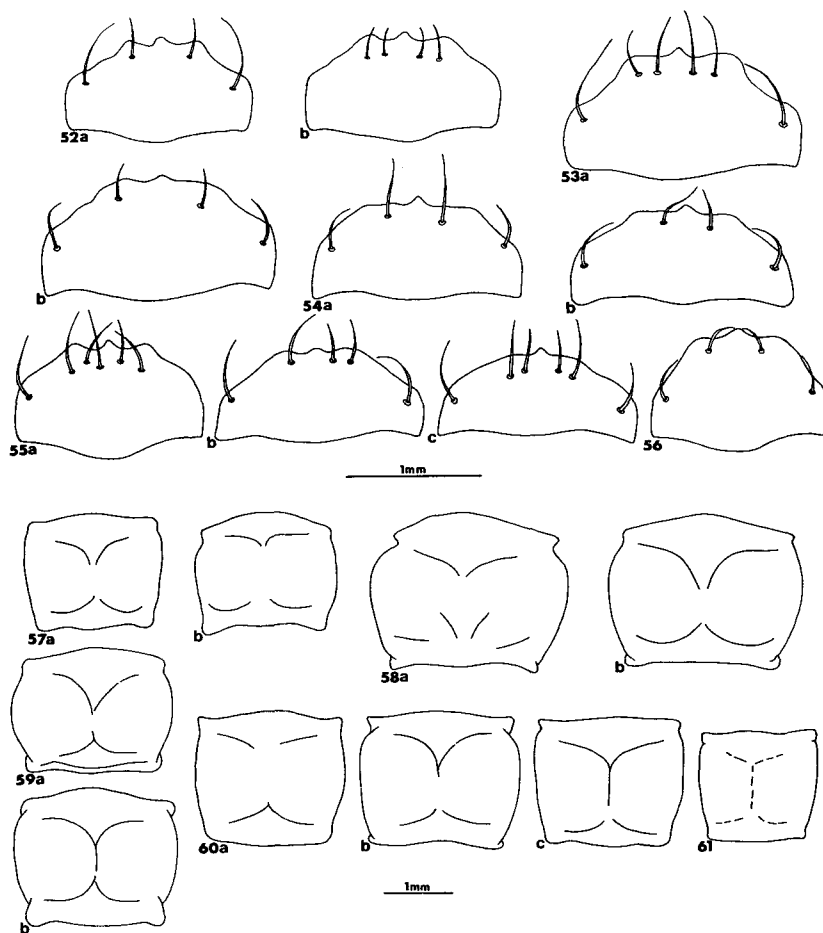
*Type species.*— *Cicindela chlorosticta* Kollar, 1836: 332 (here selected).

*Derivation of name.*— From first given names of Gayla E. Freitag, Gavin W. Freitag, Margot E. Freitag and Barbara L. Barnes (junior author), who have assisted the senior author in studies on tiger beetles.

*Recognition.*— Adults of this subgenus are distinguished by the five characters given in couplet 4 of the key. In addition the head is mainly glabrous, with elongate tridentate labrum; elytral maculations are partially reduced; the apex of the median lobe of the male consists of a short ventral hook (straight in *C. anulipes*), and a flagellum is absent from the internal sac; the spermatheca and duct together are approximately 1.0 - 2.0 mm long. (See the Recognition section of subgenus *Brasiella* for similarities between it and the subgenus *Gaymara*.)

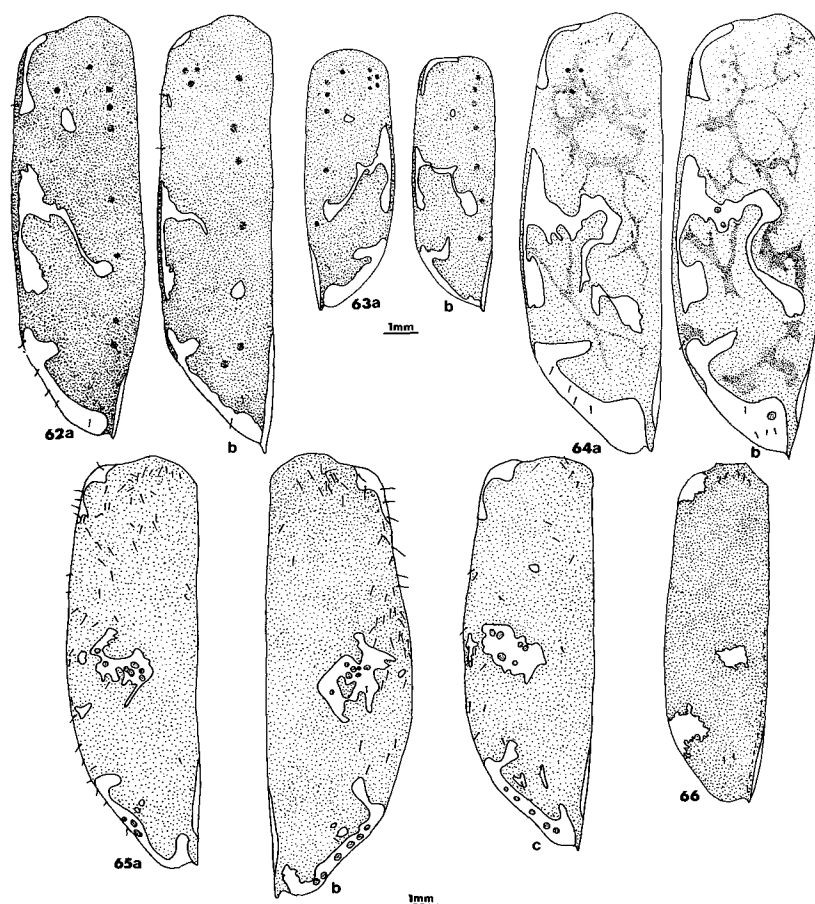
*Species groups.*— This subgenus has two groups, the *chlorosticta* group and *anulipes* group, that together include five species. Both groups are found in eastern South America mainly in southeastern Brazil.

*Geographical distribution.*— The range of this subgenus extends from northern Argentina northward to southern parts of the Amazon basin.

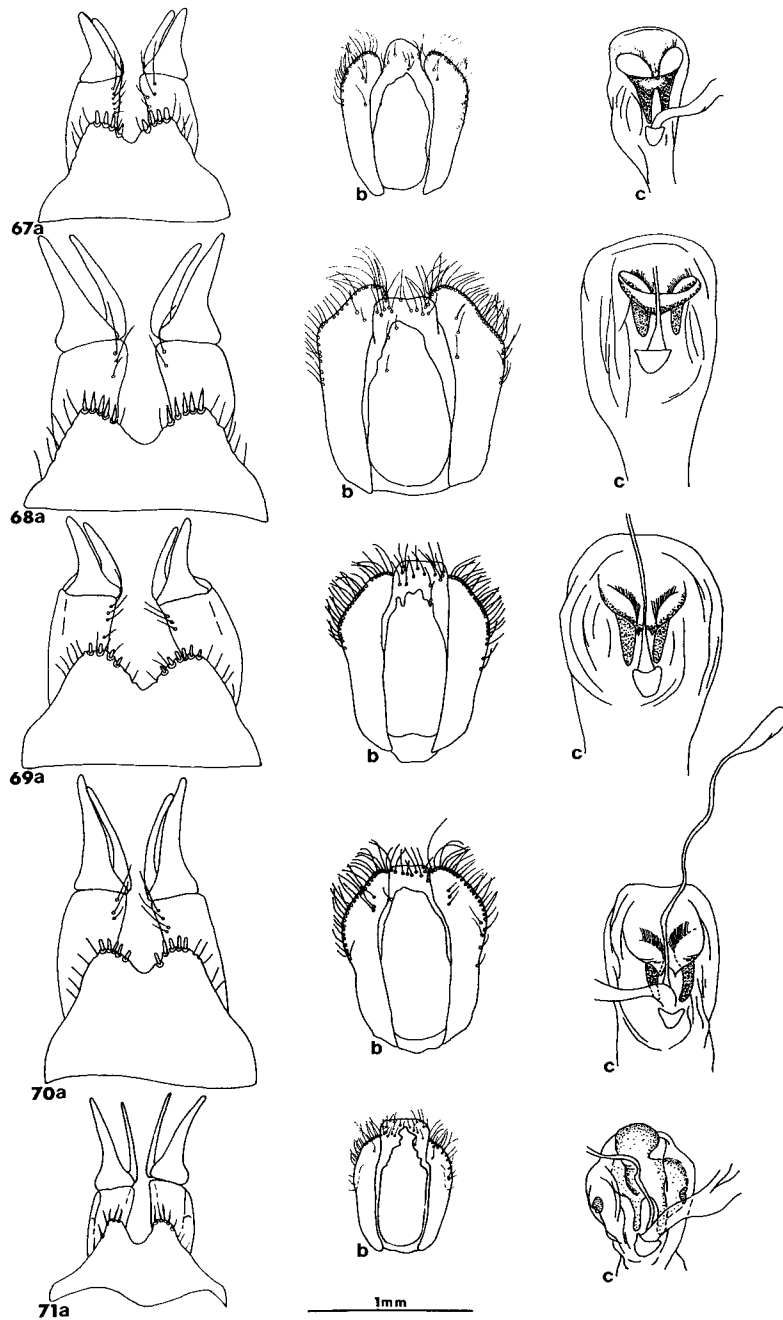


Figs. 52–56. Labrum, dorsal aspect. 52, *Cicindela chlorosticta* Kollar: (a) female, Esperanca do Sul, S.P.; (b) male, Jatai, Go.; 53, *C. staudingeria* Horn: (a) female, Jatai, Go.; (b) male, Vacaria, M. Grosso; 54, *C. nigroreticulata* Horn, Ronda Alta, R.G. do Sul: (a) female; (b) male; 55, *C. paranigroreticulata* n.sp., Tramandai, R.G. do Sul: (a), (b) female; (c) male; 56, *C. anulipes* Horn, female, Utiariti, Rio Papagaio, M. Grosso. Figs. 57–61. Pronotum, dorsal aspect. 57, *Cicindela chlorosticta* Kollar: (a) female; (b) male; 58, *C. staudingeria* Horn: (a) female; (b) male; 59, *C. nigroreticulata* Horn: (a) female; (b) male; 60, *C. paranigroreticulata* Horn n. sp.: (a), (b) female; (c) male; 61, *C. anulipes* Horn, female.





Figs. 62–66. Elytron, dorsal aspect. 62, *Cicindela chlorosticta* Kollar: (a) female; (b) male; 63, *C. staudingeri* Horn: (a) female; (b) male; 64, *C. nigroreticulata* Horn: (a) female; (b) male; 65, *C. paranigroreticulata* n. sp.: (a), (b) female; (c) male; 66, *C. anulipes* Horn, female.



Figs. 67-71. Female genitalia: (a) sternum 8, second gonocoxa, second gonapophyses, ventral aspect; (b) syntergum 9&10, dorsal aspect; (c) bursa copulatrix, oviduct sclerite, oviduct, spermatheca and duct, ventral sclerite, ventral aspect. 67, *Cicindela chlorosticta* Kollar; 68, *C. staudingeria* Horn; 69, *C. nigroreticulata* Horn; 70, *C. paranigroreticulata* n. sp.; 71, *C. anulipes* Horn.

*Phylogenetic relationships.*— Subgenus *Gaymara* is sister to the lineage that gave rise to *Plectographa* and *Cylindera*.

#### The *chlorosticta* group

Adults of this group are characterized by two swirls of rugosity between eyes, broad pronotum, and large elytral foveae. The group has four species all of which are found in Brazil, *C. chlorosticta*, *C. staudingeria*, *C. nigroreticulata*, and *C. paranigroreticulata*. The geographical range of the *chlorosticta* group extends from southeastern Brazil into southern parts of the Amazon basin. The *chlorosticta* and *anulipes* groups are sister groups.

#### *Cicindela (Gaymara) chlorosticta* Kollar

Figs. 52, 57, 62, 67, 72, 77

*Cicindela chlorosticta* Kollar, 1836: 332 (TYPE LOCALITY, in Brasiliae provincia Ypanema). Horn, 1915: 404; 1926a: 306; 1938: 52. Blackwelder, 1944: 17. Rivalier, 1954: 264; 1955: 99. Vidal Sarmiento, 1966a: 257; 1966b: 35. Sumlin, 1979: 105.

*Cicindela chlorosticta smaragdina* Horn, 1893: 198 (TYPE LOCALITY, São Paulo); 1915: 404; 1926a: 306. Blackwelder, 1944: 17.

*Recognition.*— Adults of the sister species of *C. chlorosticta* and *C. staudingeria* are distinguished from other Brazilian tiger beetles by a deeply rugose head and pronotum, bright coppery dorsum and pleuron, and pattern of elytral maculations, in particular the oblique middle band, and row of large foveae along the median suture of elytra (Figs. 62, 63). Adults of *C. chlorosticta* are distinguished from those of *C. staudingeria* by the smaller body size; a relatively narrow pronotum (Fig. 57 *cf.* Fig. 58); four setae on apex of each lobe of sternum 8 (Fig. 67a *cf.* Fig. 68a); very elongate pair of posterior extension of the ventral sclerite of the bursa copulatrix and narrow oviduct sclerite (Fig. 67c *cf.* Fig. 68c) in the female; and relatively shorter tooth (spiny field) and stylet (spiny rod) of the internal sac of the male (Figs. 72c, d *cf.* Figs. 73c, d).

*Synonyms and Types.*— Adults of *C. smaragdina* are blue or green members of *C. chlorosticta* found in São Paulo. We follow Horn, 1926a: 404 in treating *C. smaragdina* as a synonym of *C. chlorosticta*. These colour morphs appear to be rare.

#### *Description.*—

*Body length.* 8.0-8.5 mm M, ca 8.5 mm F.

*Body colour.* Head and pronotum deeply rugose, bright coppery and with some green. Elytra matte light brown or coppery, combined with a little green in some specimens. A few adults with blue or green dorsum. Pleuron glossy and bright coppery. Venter mainly coppery with some green, purple and blue; center of abdomen black with mainly purple reflections.

*Body setae.* Head glabrous. Pleuron sparsely to moderately setose. Lateral portions of abdominal sterna 1-5 (F) and 1-6 (M) with appressed setae.

*Other external features.* Vertex of head with two wide shallow pits (swirls of rugosity) between hind margins of eyes. Labrum elongate tridentate, with four to six submarginal setae (Figs. 52a, b). Pronotum broadened anteriorly, sides not protruding (Figs. 57a, b). Coupling sulcus of mesepisternum of female a

long, moderately deep groove. Apex of front trochanters with one seta. Elytra with apex slightly recurved to a well developed spine in females (Figs. 62a, b). Pattern of elytral maculations with discontinuous humeral lunule and oblique complete or discontinuous middle band (Figs. 62a, b). Punctuation of elytra green; with a row of foveate punctures along median suture and a cluster near shoulder (Figs. 62a, b).

*Female genitalia.* Sternum 8 with shallow and broad apical emargination, apices broadly rounded, each apex with four stout setae (Fig. 67a). Second gonocoxa with four or five setae in medial margin (Fig. 67a). Second gonapophyses short (Fig. 67a). Syntergum 9 and 10 as in Figure 67b. Ventral sclerite with two elongate posterior projections; row of fine setae on anterior margins (Fig. 67c). Oviduct sclerite narrow (Fig. 67c). Spermatheca and duct probably short (broken in dissection).

*Male genitalia.* Apical end of median lobe narrowly tapered (Figs. 72a, b). Internal sac without flagellum. Large tooth in the form of an elongate spiny field consisting of two lobes. Stylet joined to base of tooth short with pointed apex. Spiny rod extended beyond apical end of tooth. Arciform piece moderately broad. Central plate large (Figs. 72c, d).

*Geographical Variation.*— The dorsal colour and pattern of elytral maculations vary slightly but a geographical pattern is not evident.

*Relationships.*— *Cicindela chlorosticta* and *C. staudingeri* are sister species.

*Habitat and Period of Activity.*— Adults have been collected from October to March. Habitat unknown.

*Geographical Distribution, Localities, Examined Specimens.*— Central and southeastern Brazil to northeastern Argentina and Paraguay (Fig. 77).

Brazil. *Goiás*: Chapada, 2M, ICCM; Jataí, 2M, IOC, 3M, MZSP; Rio Verde, 1M, IOC. *Matto Grosso*: Utiariti, 1M, MZSP; Vacaria, 2M, 2F, MZSP. *São Paulo*: Avanhand (Garbe L.), 4M, 6F, MZSP; Eng. Coelho\*, 1M, 1F, IOC; Esperança do Sul\*, 1M, 1F, MZSP; Guatapara\*, 1M, 2F, MZSP; Onda Verde\*, 1F, MZSP; Piraju, 1M, 1F, MZSP.

Paraguay. Caaguazú, 1M, 1F, MNRJ.

### *Cicindela (Gaymara) staudingeri* Horn

Figs. 53, 58, 63, 68, 73, 77

*Cicindela staudingeri* Horn, 1892c: 368 (not Kraatz) (TYPE LOCALITY, São Paulo); 1915: 404; 1926a: 306. Blackwelder, 1944: 17. Sumlin 1979: 105.

*Cicindela staudingeri* Horn, (replacement name for *Cicindela staudingeri* Horn), 1915: 404; 1926a: 306; 1938: 52. Blackwelder, 1944: 17. Rivalier, 1954: 264; 1955: 99. Sumlin, 1979: 105

*Recognition.*— Adults of *C. staudingeri* are distinguished from other Brazilian tiger beetles by character combination of the large body size. *ca* 10.0-12.0 mm long, markedly rugose head and pronotum, two wide fairly deep pits between the hind margins of the eyes, bright coppery reflections from the dorsum and pleuron, particularly from the proepisternum, and pattern of elytral maculations (Figs. 63a, b). See also Recognition section for *C. chlorosticta*.

*Synonyms and Types.*— The name *C. staudingeri* is based upon comparison of the original description of *C. staudingeri* Horn with four males and one female in the IPZE, each labelled as: "Staudinger, São Paulo/Type ! Coll. W. Horn/Syntypus *Cicindela staudingeri* Horn 5".

*Description.*—

*Body length.* 10.0-11.0 mm M, 12.0 mm F.

*Body colour.* Head and pronotum deeply rugose, bright coppery and some green; elytra matte light brown and coppery and faintly green in some specimens. Pleuron glossy and bright coppery. Venter mainly

coppery with some green, blue and purple reflections; center of abdomen black with some blue, green or purple.

*Body setae.* Pleuron sparsely setose. Lateral margins of abdominal sterna 1-5 (F) and 1-6 (M) covered with appressed setae.

*Other external features.* Vertex of head of most adults with two wide shallow pits between hind margins of eyes. Labrum elongate, tridentate, weakly so in some specimens, with four to seven (most commonly six) submarginal setae (Figs. 53a, b). Pronotum broad, sides ampliate, in most specimens sutures moderately deep (Figs. 58a, b). Coupling sulcus of mesepisternum of female a long and moderately deep groove. Apex of front trochanters with one sensory seta. Elytra with apex slightly recurved to a well developed spine (Figs. 63a, b). Pattern of elytral maculations with discontinuous to almost effaced humeral lunule, middle band oblique, marginal band and apical lunule complete (Figs. 63a, b). Punctuation green. Large foveate punctures along median suture and a cluster of smaller ones near middle of shoulder (Figs. 63a, b).

*Female genitalia.* Sternum 8 with shallow and broadly rounded V-shaped apical emargination, each apex with five stout fairly long setae (Fig. 68a). Second gonocoxa with several setae in medial margin (Fig. 68a). Second gonapophyses elongate (Fig. 68a). Syntergum 9 and 10 as in Figure 68b. Ventral sclerite with two posterior projections, recurved apex and row of fine setae on apical end (Fig. 68c). Oviduct sclerite short and broad (Fig. 68c). Spermatheca and duct probably short (broken in dissection).

*Male genitalia.* Apical end of median lobe narrowly tapered (Figs. 73a, b). Internal sac without flagellum. Very long bilobed spiny field in place of the large tooth. Stylet joined to base of tooth, short, apex sharp, bent. Slender spiny rod extended far beyond apical end of tooth. Arciform piece long; central plate large. Right bar wide (Figs. 73c, d).

*Geographical Variation.*— Dorsal colour, pattern of elytral maculations, and number of submarginal setae of the labrum vary within populations, though geographical patterns of variation are not apparent.

*Relationships.*— *Cicindela staudingeria* and *C. chlorosticta* are sister species.

*Habitat and Period of Activity.*— Adults have been collected from October to March. Habitat unknown.

*Geographical Distribution, Localities, Examined Specimens.*— Southeastern Brazil to northern Argentina and Uruguay (Fig. 77).

Brazil. *Goiás*: Chapada, 6M, 5F, ICCM: Jataí, 1F, IOC, 1F, MZSP. *Matto Grosso*: Murtinho\*, 1M, IOC; no locality, 2M, 3F, MZSP. *São Paulo*: Batatais, 1M, IOC; no locality, 1M, IOC, 1M, 1F, MZSP.

Uruguay. Rivera, 2M, MNRJ; Tacuarembó, 1F, MNRJ.

### *Cicindela (Gaymara) nigroreticulata* Horn

Figs. 54, 59, 64, 69, 74, 77

*Cicindela nigroreticulata* Horn, 1927: 139 (TYPE, a female in IPZE bearing the following label: "Cochilha Grande R. Grande d. Sul/Type W. Horn/ Holotypus (black letters on red label)/*nigroreticulata*"; TYPE LOCALITY, Cochilha Grande, Rio Grande do Sul); 1938: 52. Blackwelder, 1944: 19.

*Recognition.*— Adults of *C. nigroreticulata* are distinguished from those of other Brazilian species by the colouration of the elytra and pattern of elytral maculations. Many dark brown lines form a reticulated pattern against the lighter brown and coppery ground colour, and the middle band is strongly curved (Figs. 64a, b). In addition, the labrum is unidentate or weakly tridentate with 4 submarginal setae (Figs. 54a, b), and a pair of wide pits are located between the hind margins of the eyes.

*Description.*—

*Body length.* 9.0 mm M, ca 9.0-9.5 mm F.

*Body colour.* Dorsum of head and pronotum slightly glossy, with bright coppery and green reflections; elytra dull brown coppery or green, with a reticulated pattern formed by many dark brown lines (Figs. 64a, b). Venter glossy, with green and coppery reflections.

*Body setae.* Pleuron, lateral portions of abdominal sterna with sparsely to moderately dense appressed setae, most of the mesepisternum glabrous.

*Other external features.* Vertex of head and pronotum deeply rugose. Two wide pits located on vertex between hind margins of eyes. Tooth of mentum elongate. Labrum unidentate or weakly tridentate, four submarginal setae (Figs. 54a, b). Pronotum broad, sides ampliate, sutures deep (Figs. 59a, b). Coupling sulcus of mesepisternum of female a groove with center depressed. Legs red-coppery throughout. Apex of front trochanters with one seta. Elytra tapered apically, apex recurved to short apical spine. Maculations of elytra separate and clearly defined; humeral lunule short not reaching central disc, middle band strongly curved (Figs. 64a, b); punctuation almost effaced, large shallow punctures near shoulders and anterior portions of disc beside median suture.

*Female genitalia.* Sternum 8 with shallow V-shaped posterior emargination; apices broadly rounded each with four to six short thick setae (Fig. 69a). Second gonocoxa with a few setae on median edge (Fig. 69a). Second gonapophyses short and broad at base (Fig. 69a). Syntergum 9 and 10 broadened posteriorly (Fig. 69b). Ventral sclerite bulbous, with two elongate posterior projections, row of fine setae on anterior dorsal margin (Fig. 69c). Oviduct sclerite shield-like, well sclerotized (Fig. 69c). Spermatheca and duct elongate (broken in dissection), greater than 1.5 mm in length.

*Male genitalia.* Apical end of median lobe slender, apex with sharp ventral emargination (Figs. 74a, b). Internal sac without flagellum. Stylet short sinuate, apex sharp, joined to base of tooth. Elongate unsclerotized spiny field-like bilobed tooth and thin rod each of equal length. Two basal membranous lobes present. Arciform piece slender; central plate large. Right bar narrow, elongate (Figs. 74c, d).

*Geographical Variation.*— The pattern of reticulations on the elytra varies appreciably within and among populations.

*Relationships.*— *Cicindela nigroreticulata* and *C. paranigroreticulata* are sister species.

*Habitat and Period of Activity.*— Adults have been collected in February. Habitat unknown.

*Geographical Distribution, Localities, Examined Specimens.*— Inland Rio Grande do Sul, Brazil (Fig. 77).

Brazil. *Rio Grande do Sul: Cochilha Grande*, 1F (holotype), IPZE; *Ronda Alta*<sup>\*</sup>, 1M, 2F, MNRJ; *Santo Augusto*<sup>\*</sup>, 2M, 1F, ICCM.

*Cicindela (Gaymara) paranigroreticulata* new species

Figs. 55, 60, 65, 70, 75, 77

*Type Specimens.*— HOLOTYPE, a female in the collection of MNRJ labelled: "Brasil Rio Gde. do Sul Tramandai 14-11-64 C.S. Carbonell A. Mesa y M.A. Monné/Holotype *Cicindela paranigroreticulata* R. Freitag, B.L. Barnes" (red label). PARATYPES, one male and one female in the MNRJ labelled same as Holotype, but type label is: "Paratype *Cicindela paranigroreticulata* R. Freitag and B.L. Barnes" (blue label). TYPE LOCALITY, Tramandai Rio Gde do Sul.

*Recognition.*— The character state combination of black body, large body size, 8.0-9.0 mm long, extensive head and body pubescence, setose elytra, and pattern of elytral maculations (Figs. 65a-c) distinguish adults of *Cicindela paranigroreticulata* from those of other Brazilian species of *Cicindela*.

*Description.*— *Body length.* 8.0 mm M, ca 9.0 mm F.

*Body colour.* Head, pronotum, pleuron and venter slightly glossy; elytra dull. Body black with obscure green and coppery reflections on the elytra and pleuron. Four basal articles of the antenna coppery and green; articles 5-11 moderate pale rufopiceous. Legs with coppery and green reflections.

*Body setae.* Vertex, frons, clypeus and genae with scattered setae, and a tuft of setae on the front inner margins of each eye. Pronotum setose, except for central disc. Elytra sparsely setose mainly on basal 0.5, medial along suture and lateral margins. Pleuron, lateral portion of metasternum, and later portions of abdominal sterna moderately setose. Dorsal 0.5 of mesepisternum glabrous.

*Other external features.* Vertex of head deeply rugose. Two obsolete wide pits (swirls of rugosity) on vertex between hind margins of eyes. First antennal article with one long apical seta and one short medial seta. Tooth of mentum elongate. Labrum elongate tridentate; six to eight submarginal setae (Figs. 55a-c). Pronotum broad expanded in apical 0.5 (Figs. 60a-c). Coupling sulcus of mesepisternum of female an elongate groove with deep middle. Procoxa, mesocoxa and lateral portion of metacoxa moderately setose. Apex of front trochanters with one seta. Femora, tibia, and tarsi moderately setose. Apex of elytra recurved to small spine; maculations of elytra reduced, humeral lunule short, middle band discontinuous not reaching lateral margin of elytra, apical lunule elongate (Figs. 65a-c). Elytral punctations shallow marked by green and coppery metallic spots; a row of larger punctures near median suture and another short row inside the shoulder; microsculpture mainly isodiametric. Apices of elytra with microserrations.

*Female genitalia.* Sternum 8 with shallow U-shaped posterior emargination; apices broadly rounded each with five short thick setae (Fig. 70a). Second gonocoxa with a few setae on medial edge (Fig. 70a). Second gonapophyses elongate (Fig. 70a). Syntergum 9 and 10 broadened posteriorly (Fig. 70b). Ventral sclerite wide, lightly sclerotized, two elongate posterior projects slightly curved medially, row of fine setae on dorsal anterior margin (Fig. 70c). Oviduct sclerite lightly sclerotized, almost transparent, shield-shaped with lateral flanges (Fig. 70c). Length of spermatheca and duct ca 2.0 mm.

*Male genitalia.* Apical end of median lobe slender, apex sharply hooked posteriorly (Figs. 75a, b). Internal sac was accidentally everted. Flagellum absent. Stylet joined to base of tooth very short, stout with pointed apex. Spiny field-like bilobed tooth and two rod-like extensions of equal length. Arciform piece slender; central plate large. Right bar was not seen (Figs. 75c, d).

*Relationships.*— *Cicindela paranigroreticulata* and *C. nigroreticulata* are sister species.

*Habitat and Period of Activity.*— Type collected on or beside ocean shore, February or November, 1964.

*Geographical Distribution, Localities, Examined Specimens.*— Known only from Tramandai, Rio Grande do Sul, Brazil (Fig. 77).

Brazil. *Rio Grande do Sul*: Tramandai, 1F (holotype), 1M, 1F, (paratypes), MNRJ.

#### The *anulipes* group

Adults of this group are characterized by some or all setae of labrum positioned very near the anterior margin, and long mentum tooth. The group has only one species, *C. anulipes*, which is found in southeastern Brazil and the Brazilian Highlands. This group and the *chlorosticta* group are sister groups.

#### *Cicindela (Gaymara) anulipes* Horn

Figs. 56, 61, 66, 71, 76, 77

*Cicindela anulipes* Horn, 1897a: 255 (TYPE, a male in the IPZE bearing the following labels: "Staudinger, Minas Geraes/Type !, Dr. W. Horn/ Holotypus" (black letters on red label) "*Cicindela anulipes* Horn"; TYPE LOCALITY, Minas Geraes); 1915: 405; 1923: 112; 1926a: 307; 1938: 58. Blackwelder, 1944: 16. Rivalier, 1954: 264; 1955: 99.

*Recognition.*— The character state combination of the elongate and weakly tridentate labrum, deep and evenly distributed punctures of the proepisternum, pattern of the elytral maculations reduced in extent (Fig. 66), sclerotized oviduct sclerite and shape of ventral sclerite of the bursa copulatrix distinguishes *C. anulipes* from other species of *Cicindela* in Brazil. The internal sac of the male contains a unique bifid stylet (Fig. 76c).

*Synonyms and Types.*— The name is based upon examination of the type specimen and other specimens on loan.

*Description.*—

*Body length.* 7.0-7.5 mm M, 7.5 mm F.

*Body colour.* Dorsum dull, black; elytra matte and slightly velvety. Venter and pleuron black with green, coppery and blue reflections; legs with testaceous sections.

*Body setae.* Margins of pronotum, proepisternum, mesepisternum and lateral margins of abdominal sterna 1-6 with appressed setae. Elytra with a few erect setae near shoulder.

*Other external features.* Tooth of mentum long. Labrum elongate, convex, slightly tridentate; four submarginal setae (Fig. 56). Pronotum narrowed at posterior end, sutures shallow (Fig. 61). Punctures of proepisternum deep and evenly distributed. Coupling sulcus of mesepisternum of female a broad and moderately deep groove. Apex of front trochanters each with one seta. Elytra with apical end tapered and slightly recurved to a small spine (Fig. 66). Pattern of elytral maculations with humeral spot on shoulder, middle spot on disc, and marginal spot near the apex (Fig. 66). A small portion of the marginal band may or may not be present. Punctures of elytra large gradually becoming deeper near shoulder. Elytra with a few erect setae near shoulder.

*Female genitalia.* Sternum 8 with deep and narrow emargination in apical end, apices each acutely rounded, and with 5 thick setae (Fig. 71a). Second gonapophyses elongate, narrow, median portion almost as long as lateral portion (Fig. 71a). Syntergum 9 and 10 as in Figure 71b. Ventral sclerite with wide apical end spatulate and deflected dorsally (Fig. 71c); two elongate posterior projections (Fig. 71c). Oviduct sclerite short (Fig. 71c). Spermatheca and ducts ca 1.0 mm long.

*Male genitalia.* Apical end of median lobe slender, apex not hooked (Figs. 76a, b). Internal sac without flagellum. Stylet unique bifid, joined to base of tooth, elongate. Tooth spiny field with long stylet-like piece. Arciform piece very wide; central plate large; right bar present (Figs. 76c, d).

*Geographical Variation.*— Patterns of geographical variation in examined adult characteristics were not apparent. Some adults had a marginal spot on the elytra.

*Relationships.*— *Cicindela anulipes* is sister to the lineage that gave rise to sister species *C. chlorosticta* and *C. staudingeria*, and sister species *C. nigroreticulata* and *C. paranigroreticulata*.

*Habitat and Period of Activity.*— Unknown.

*Geographical Distribution, Localities, Examined Specimens.*— Goiás, Matto Grosso, Minas Gerais, and Rio Grande do Sul (Fig. 77).

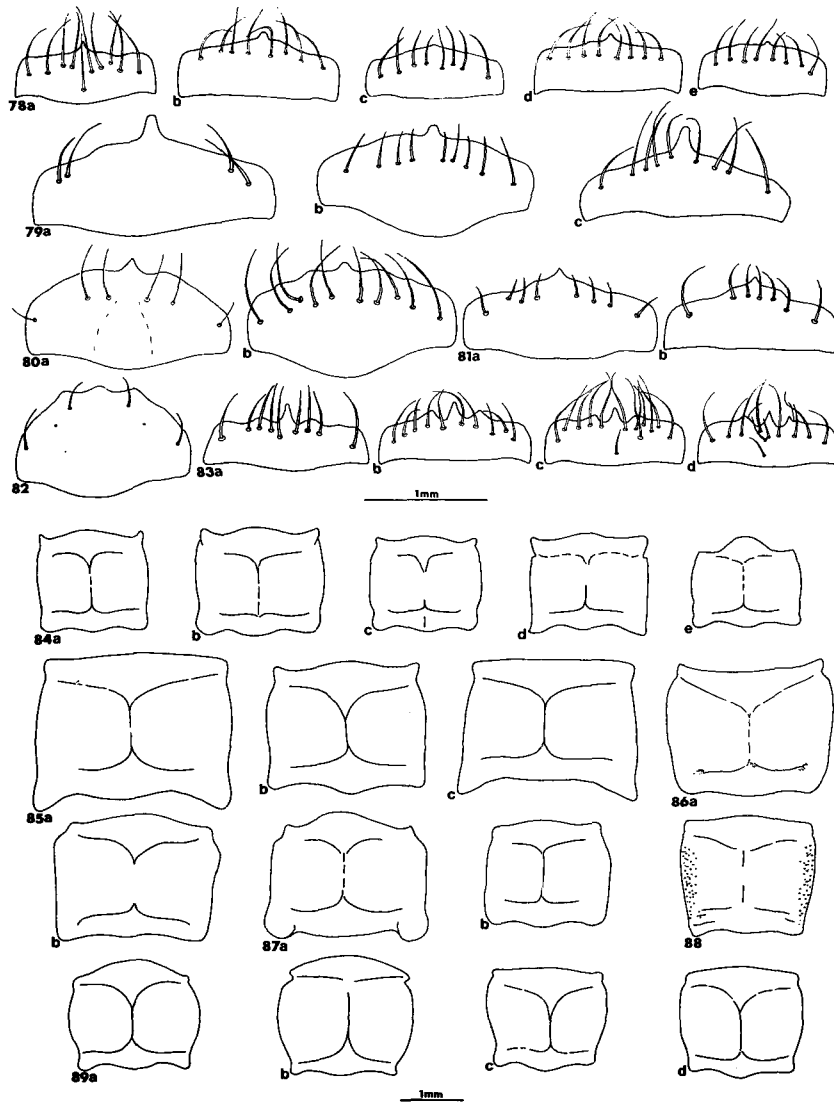
Brazil. *Goiás:* Chapada, 2M, 5F, ICCM; Jatai, 1F, IOC, 3M, 11F, MZSP; Jolaby\*, 1F, MZSP. *Matto Grosso:* Utiariti, 9M, 10F, MZSP. *Minas Gerais:* no locality, 1M, IPZE, 1F, MZSP. *Rio Grande do Sul:* Tramandai, 3M, 2F, MNRJ.

### Subgenus *Plectographa* Rivalier

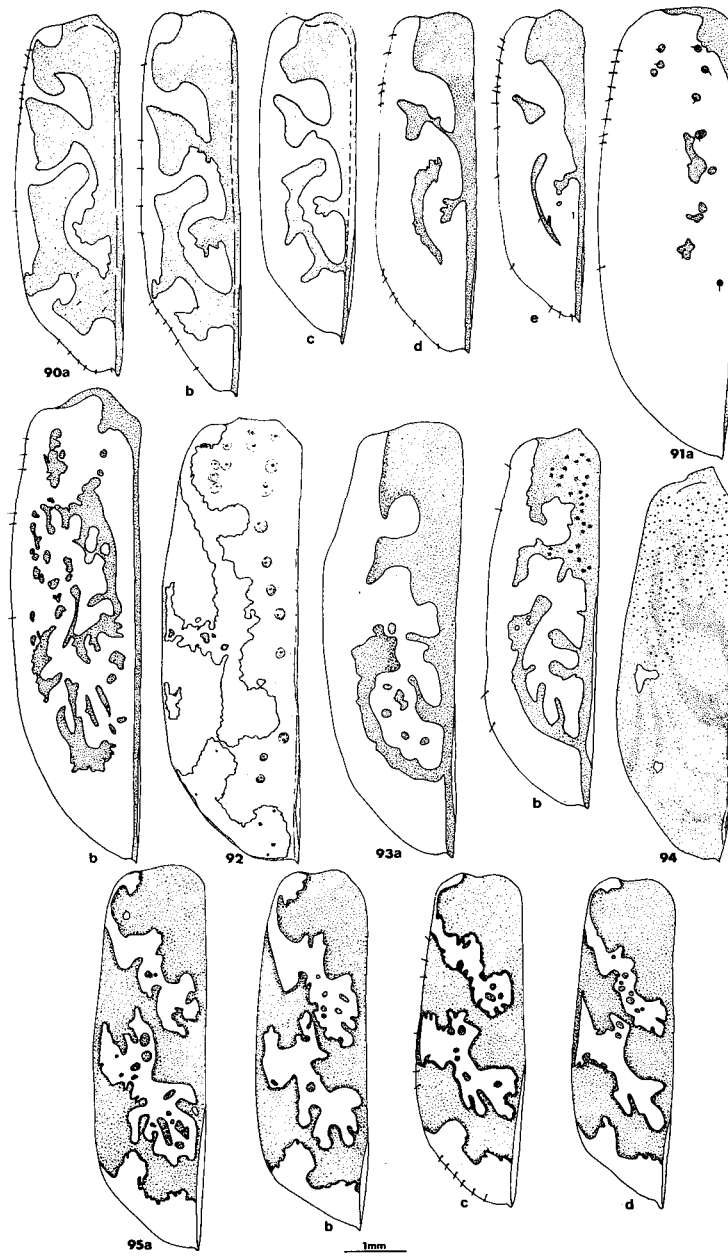
Subgenus *Plectographa* Rivalier, 1954: 265 (TYPE SPECIES, *Cicindela gormazi* Reed, by original designation).

*Recognition.*— Adults of this subgenus are distinguished by the four characters given in couplet 5 of the key. In addition the labrum is basically unidentate with 4-11 submarginal setae; apical end of the median lobe is tapered and not hooked; in

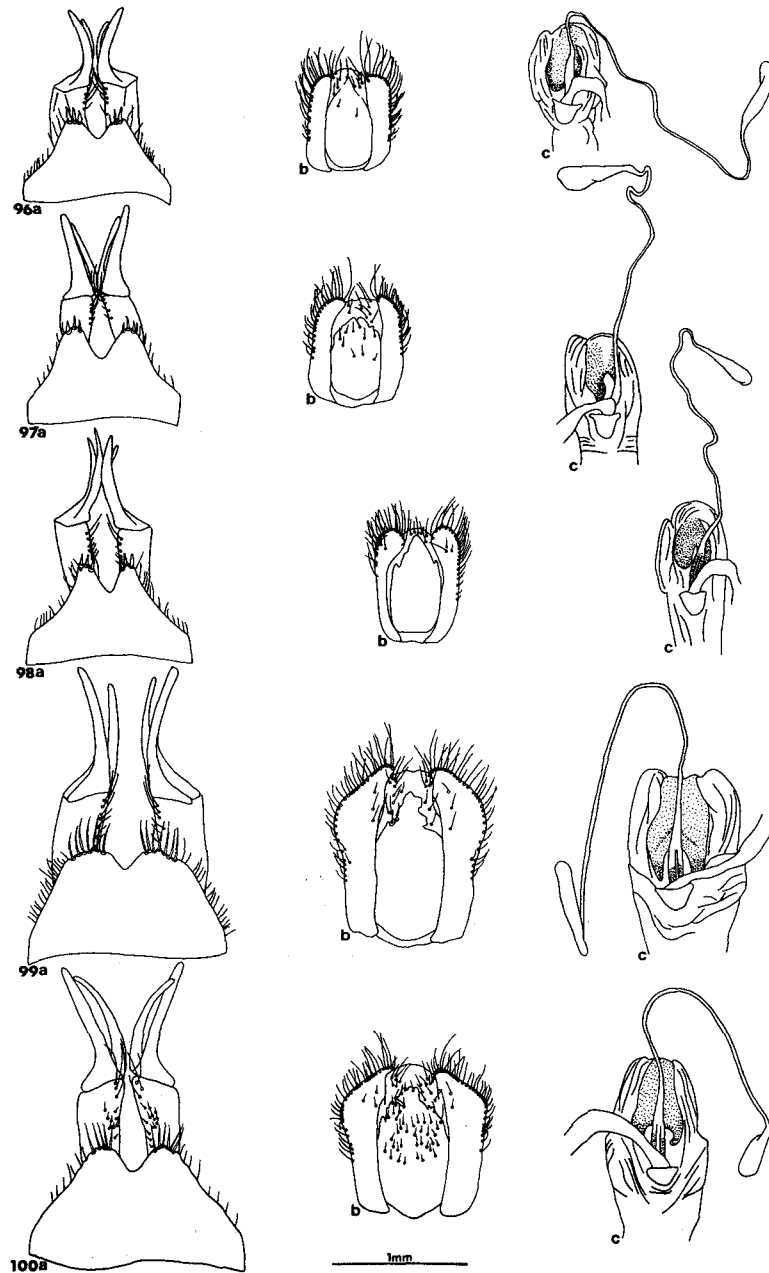




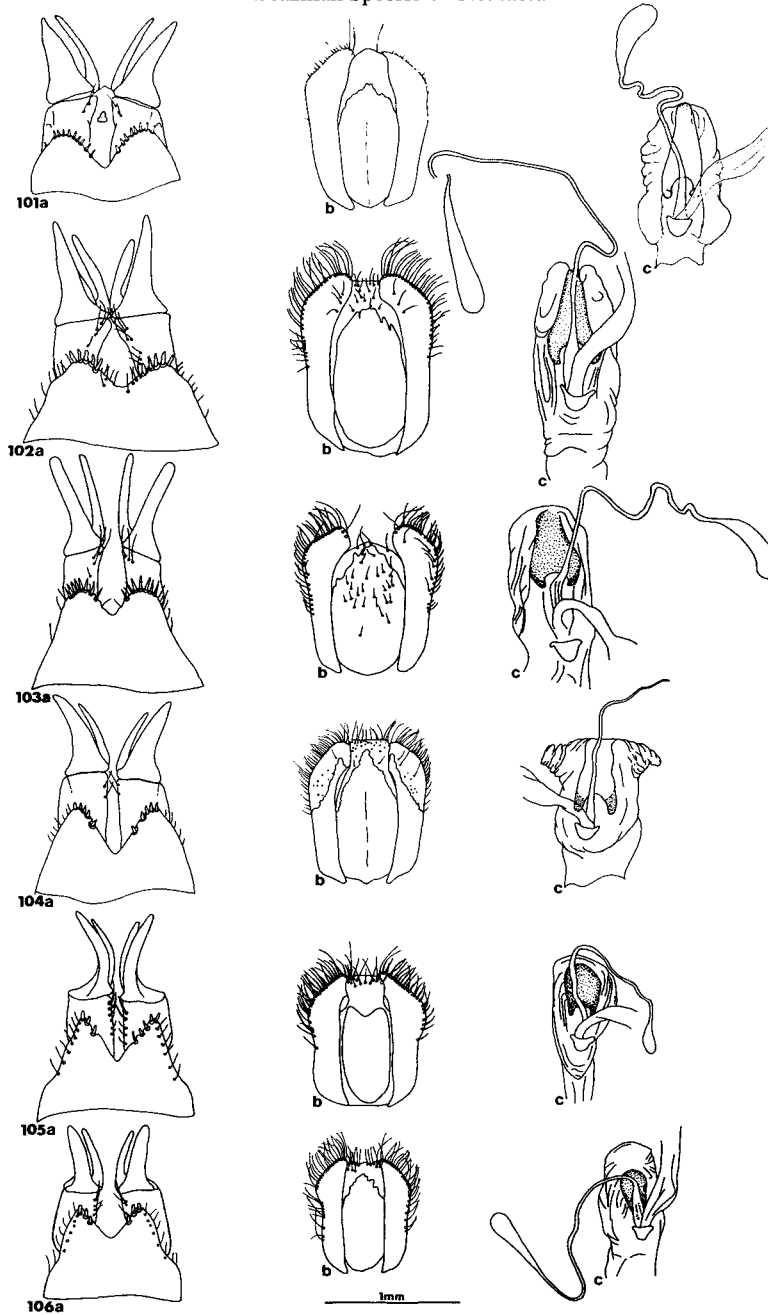
Figs. 78–83. Labrum, dorsal aspect. 78, *Cicindela suturalis* Fabricius: (a) female, Maturaca, Am.; (b) female, (c) male, Russas, Ce.; (d) female, (e) male, São Luis, Mar.; 79, *C. nivea* Kirby: (a) female, (b) male, Florianópolis, Sta. Cat.; (c) female, Vacaria, M. Grosso; 80, *C. melaleuca* Dejean: (a) female, Rio Grande do Sul; (b) female, Buenos Ayres, B.A.; 81, *C. patagonica* Brullé: (a) *C. p. cherubim* Chevrolat, female, Montevideo, Uruguay; (b) *C. p. bergiana* Horn, male, Rio Grande do Sul; 82, *C. nigrovittata* Horn, female, Minas Gerais; 83, *C. apiata* Dejean: *C. a. apiata*, (a) female, (b) male, Rio de Janeiro, R.d.J.; *C. a. clausenii* Putzeys, (c) female, (d) male, Rio Grande do Sul. Figs. 84–89. Pronotum, dorsal aspect. 84, *Cicindela suturalis* Fabricius: (a) female, Maturaca, Am.; (b) female, (c) male, Russas, Ce.; (d) female, (e) male, São Luis, Mar.; 85, *C. nivea* Kirby: (a) female, (b) male, Florianópolis, Sta. Cat.; (c) female, Vacaria, M. Grosso; 86, *C. melaleuca* Dejean: (a) female, Rio Grande do Sul; (b) female, Buenos Ayres, B.A.; 87, *C. patagonica* Brullé: (a) *C. p. cherubim* Chevrolat, female, Montevideo, Uruguay; (b) *C. p. bergiana* Horn, male, Rio Grande do Sul; 88, *C. nigrovittata* Horn, female, Minas Gerais; 89, *C. apiata* Dejean: *C. a. apiata* (a) female, (b) male, Rio de Janeiro, R.d.J.; *C. a. clausenii* Putzeys, (c) female, (d) male, Rio Grande do Sul.



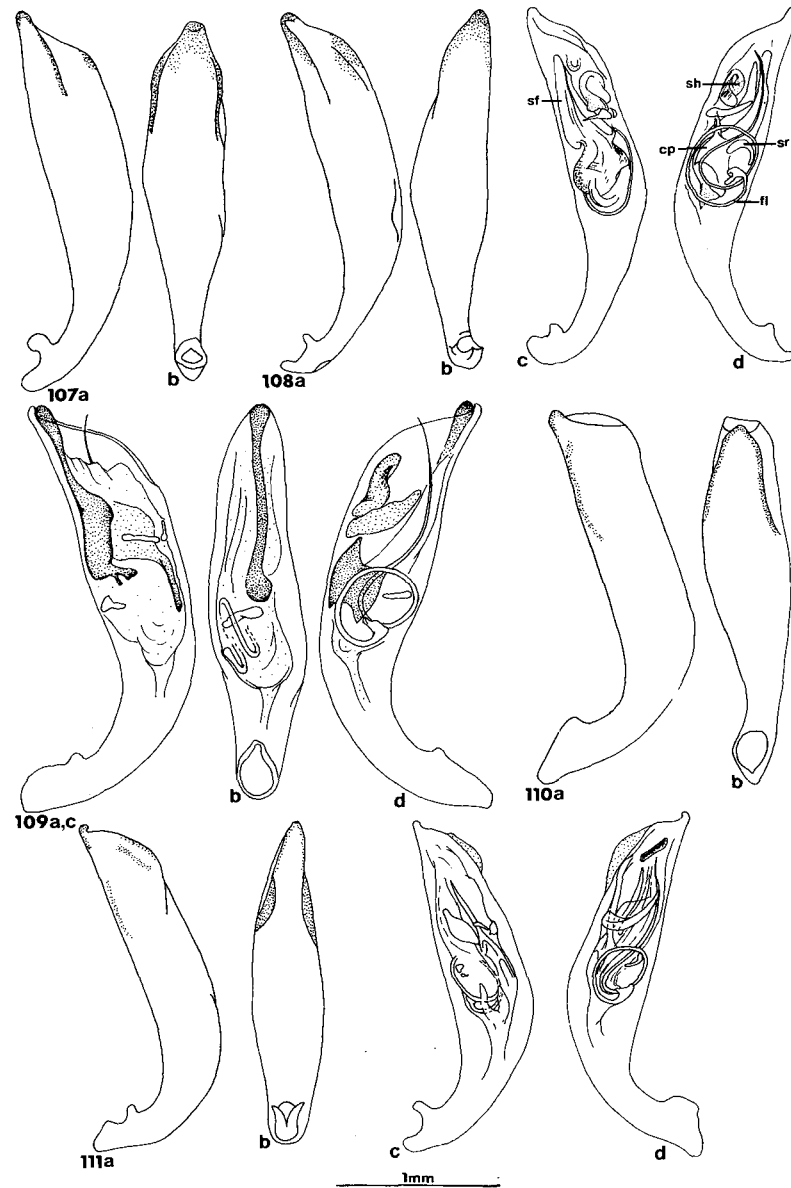
Figs. 90–95. Elytron, dorsal aspect. 90, *Cicindela suturalis* Fabricius: (a) female, Maturaca, Am.; (b) female, (c) male, Russas, Ce.; (d) female, (e) male, São Luis, Mar.; 91, *C. nivea* Kirby: (a) male, Florianópolis, Sta. Cat.; (b) female, Vacaria, M. Grosso; 92, *C. melaleuca* Dejean, female, Rio Grande do Sul; 93, *C. patagonica* Brullé: (a) *C. p. cherubim* Chevrolat, female, Montevideo, Uruguay; (b) *C. p. bergiana* Horn, male, Rio Grande do Sul; 94, *C. nigrovittata* Horn, female, Minas Gerais; 95, *C. apiata* Dejean: *C. a. apiata* (a) female, (b) male, Rio de Janeiro, R.d.J.; *C. a. clausenii* Putzeys, (c) female, (d) male, Rio Grande do Sul.



Figs. 96–100. Female genitalia: (a) sternum 8, second gonocoxa, second gonapophyses, ventral aspect; (b) syntergum, 9 & 10, dorsal aspect; (c) bursa copulatrix, oviduct sclerite, oviduct, spermatheca and duct, ventral sclerite, ventral aspect. *Cicindela suturalis* Fabricius: 96, Maturaca, Am.; 97, Russas, Ce.; 98, São Luis, Mar.; *C. nivea* Kirby: 99, Florianopolis, Sta. Cat.; 100, Vacaria, M. Grosso.



Figs. 101–106. Female genitalia: (a) sternum 8, second gonocoxa, second gonapophyses, ventral aspect; (b) syntergum, 9 & 10, dorsal aspect; (c) bursa copulatrix, oviduct sclerite, oviduct, spermatheca and duct, ventral sclerite, ventral aspect. *C. melaleuca* Dejean: 101, Rio Grande do Sul; 102, Buenos Ayres, B.A.; 103, *C. patagonica cherubim* Chevrolat, Montevideo, Uruguay; 104, *C. nigrovittata* Horn, Minas Gerais; 105, *C. apiata apiata* Dejean, Rio de Janeiro, R.d.J.; 106, *C. a. clausenii* Putzeys, Rio Grande do Sul.



Figs. 107–111. Male genitalia: median lobe (a) right lateral aspect, (b) dorsal aspect; (c) internal sac, arciform piece, central plate (*cp*), flagellum (*fl*), right bar, shield (*sh*), spatulate field (*sf*), small stiffening rib (*sr*), stylet, tooth, right lateral aspect; (d) left lateral aspect. *Cicindela suturalis* Fabricius: 107, Russas, Ce.; 108, São Luis, Mar.; 109, *C. nigrovittata* Horn, Minas Gerais; 110, *C. apiata apiata* Dejean, Rio de Janeiro, R.d.J.; 111, *C. a. clausenii* Putzeys, Rio Grande do Sul.



Fig. 112. Map showing the geographical distribution of the species *Cicindela suturalis* Fabricius (●), *C. nivea nivea* Kirby (■), and *C. n. orbigny* Guérin-Méneville (▲). Open circles represent state records, and those with an adjacent point indicate records taken from the literature for *C. suturalis* Fabricius.



Fig. 113. Map showing the geographical distribution of the species *Cicindela melaleuca* Dejean (●), and *C. patagonica* Brullé (■).



Fig. 114. Map showing the geographical distribution of the species *Cicindela nigrovittata* Horn (◆), *C. apiata apiata* Dejean (●), and *C. a. clausenii* Putzeys (■). Open circles are state or country records for *C. apiata apiata* Dejean taken from the literature.



females the ventral sclerite of the bursa copulatrix is glabrous and has two elongate posterior projections; the spermatheca and duct together are approximately 2.5 - 4.5 mm long.

*Species groups.*— This subgenus has five species groups that include 18 species. Four groups, *suturalis* group, *melaleuca* group, *nigrovittata* group, and *apiata* group, are found in Brazil.

*Geographical distribution.*— The geographical range of this subgenus extends from temperate Chile and Patagonia northward to the West Indies, and is centered in northern Argentina.

*Phylogenetic relationships.*— *Plectographa* and *Cylindera* are sister subgenera.

#### The *suturalis* group

Adults of this group are characterized by bright coppery and some green body colouration. The group has seven species, two of which, *C. suturalis* and *C. nivea* are found in Brazil. The geographical range of the *suturalis* group extends from central Chile and Patagonia northward to the West Indies, and is centered in northern Argentina. The *suturalis* and *melaleuca* groups are sister groups.

#### *Cicindela (Plectographa) suturalis* Fabricius

Figs. 78, 84, 90, 96, 97, 98, 107, 108, 112

- Cicindela suturalis* Fabricius, 1798: 62 (TYPE LOCALITY, in America St. Thomas); 1801: 242.—Herbst, 1806: 207.—Dejean, 1825: 129.—Horn, 1915: 403; 1926a: 305; 1938: 52.—Leng and Mutchler, 1916: 693.—Blackwelder, 1944: 20.—Jonge Poerink, 1953: 133.—Rivalier, 1954: 266.—Balazuc and Chalumeau, 1978: 22-25.—Ivie, 1983: 195.
- Cicindela trifasciata* Dejean, 1825: 85(not Fabricius) (TYPE LOCALITY, Cayenne).—Horn, 1915: 403; 1926a: 306.—Blackwelder, 1944: 20.
- Cicindela hebraea* Klug, 1834: 20 (TYPE LOCALITY, Cayenne).—Putzeys, 1874: 117.—Horn, 1915: 403; 1926a: 306; 1938: 52.—Leng and Mutchler, 1916: 694.—Varas Arangua, 1930: 154.—Blackwelder, 1944: 20.—Jonge Poerink, 1953: 135.—Rivalier, 1954: 266.—Mandl, 1963: 578.—Balazuc and Chalumeau, 1978: 25.
- Cicindela hieroglyphica* Klug, 1834: 30 (TYPE LOCALITY, Pará in Brasilien).—Horn, 1915: 403; 1926a: 306.—Blackwelder, 1944: 20.
- Cicindela chlorocephala* Mannerheim, 1837: 17 (TYPE LOCALITY, in insula Porto Rico).—Horn, 1915: 403; 1926a: 306.—Blackwelder, 1944: 20.
- Cicindela insidiosa* Gistel, 1837: 48 (TYPE LOCALITY, in America septentrionali, in Antillis).—Horn, 1915: 403; 1926a: 306.
- Cicindela nocturna* Steinheil, 1875: 96 (TYPE LOCALITY, Magdalenae fluminis, Colombia).—Horn, 1915: 403; 1926a: 306; 1938: 52.—Leng and Mutchler, 1916: 694.—Blackwelder, 1944: 20.—Jonge Poerink, 1953: 137-138.—Rivalier, 1954: 266.—Mandl, 1958: 26.—Balazuc and Chalumeau, 1978: 26.
- Cicindela hebraea guadeloupensis* Fleutiaux and Sallé, 1889: 358 (TYPE LOCALITY, Guadeloupe).—Horn, 1915: 403; 1926a: 306.—Leng and Mutchler, 1916: 694.—Blackwelder, 1944: 20.—Jonge Poerink, 1953: 137.—Balazuc and Chalumeau, 1978: 25.
- Cicindela suturalis helvaea* Horn, 1903: 333 (not Klug) (TYPE LOCALITY, Ciudad Bolivar, Venezuela).
- Cicindela trifasciata boliviana* Mandl, 1956: 386 (TYPE LOCALITY, Santa Cruz); 1958: 26; 1964: 16.
- NEW SYNONYMY.

*Recognition.*— Narrow to broad distinctive elytral maculations (Figs. 90a-e) and a unidentate labrum bearing 8-10 submarginal setae (Figs. 78a-e) distinguish specimens of this species.

*Synonyms and Types.*— Names were based upon comparison of original descriptions with specimens on loan.

*Description.*—

*Body length.* 6.5-8.0 mm M, 6.5-9.0 mm F.

*Body colour.* Head, pronotum and elytra slightly glossy with coppery, green, and less frequently blue, reflections. Pleuron and venter mainly coppery, and green.

*Body setae.* Dense appressed setae on lateral portions of pronotum, pleuron, ventral 0.33 of mesepisternum, and abdominal sterna 1-6.

*Other external features.* Labrum unidentate with eight to 10 (more frequently eight) submarginal setae (Figs. 78a-e). Pronotum with parallel sides, sutures moderately deep (Figs. 84a-c). Coupling sulcus of mesepisternum of female a deep sinuate groove. Apex of front trochanters with a single sensory seta. Elytra with long apical spine, (longer in *C. hebraea* form specimens); maculations complete and joined together, broadened in *C. suturalis* form specimens; punctations generally deep, subsutural row of large punctures absent (Figs. 90a-e); microsculpture isodiametric; apical serrulations present.

*Female genitalia.* Sternum 8 with deep V-shaped apical emargination, apices each with three (less frequently two) medium length setae (Figs. 96a-98a); second gonocoxa with a few long and short setae along medial margin (Figs. 96a-98a); second gonapophyses as in Figures 96a-98a; syntergum 9 and 10 as in Figures 96b-98b; bursa with right lateral extension; ventral sclerite lightly sclerotized with posterior lateral extensions, median ridge absent (Figs. 96c-98c) oviduct sclerite with well developed lateral extensions (Figs. 96c-98c); length of spermatheca and duct 3.00-3.25mm.

*Male genitalia.* Median lobe with short blunt apex (Figs. 107a, b-108a, b). Internal sac with flagellum 1.5 loops at base. Stylet present next to tooth, the large spatulate apex of tooth characteristic of *Plectographa* forms not elongate. Arciform piece, right bar, central plate, shield and small stiffening rib all well developed (Figs. 107c, d-108c, d).

*Geographical Variation and Subspecies.*— Populations composed of specimens with narrow to broad but well defined elytral maculations are widespread in Brazil. At least one identified specimen with continuous pale maculations (*C. suturalis* form) has been collected near Manaus. In most specimens the maculations are broad (*C. hebraea* form). They may be continuous in part (Figs. 90d, e) or the lunules may be clearly discernible (Figs. 90a-c). Specimens with narrow elytral maculations (*C. nocturna*, *C. guadeloupensis* or *C. boliviana* forms) are less frequent. The form of the elytral maculations seems to be variable in local populations, and geographical patterns are not evident. In addition the female genitalia tend to be uniform within and among populations (Figs. 96-98).

Morphologically distinct geographical populations, in Brazil at least, apparently do not occur, and consequently we have not applied subspecific names. A varied elytral pattern and other discordant characteristics predominate in populations of *C. suturalis* in South America north of Brazil and the West Indies. A thorough revision is required as regional studies of this species (complex) have not led to taxonomic stability (Leng and Mutchler, 1916: 693-695; Jonge Poerink, 1953: 133-138; Mandl, 1958: 24-28; Balazuc and Chalumeau, 1978: 23).

*Relationships.*— *Cicindela suturalis* and *C. sinuosa* Brullé (n. Argentina, Paraguay and Uruguay) are sister species.

*Habitat and Period of Activity.*— Specimens have been collected on sea beaches and on extensive sand beaches along rivers (Pearson, 1984) during February, May, June, September and December.

*Geographical Distribution, Localities, Examined Specimens.*— Islands of the Caribbean from Jamaica and Hispaniola south to Trinidad, northern half of South America south to southeastern Brazil (Fig. 112).

Bolivia. Cochabamba, 1F, MZSP.

Brazil. *Amazonas*: Arima (near Rio Purus), 1F, ICCM, Barcelos, 1M, MZSP; Manaus, 1M, INPA, 1M, MZSP; Manaus (Ilha de Marchantaria), 2M, 1F, INPA; Maturaca (Alto Rio Cauaburi), 1F, MZSP; Nova Olinda, 7F, ICCM; Tapuruquara, 1F, MZSP. *Bahia*: Canavieiras, 1M, IOC; Encruzilhada (980m), 1M, RRMC; Joazeiro, 1F, ICCM; Rio São Francisco\*, 2F, IOC; Villa Nova\*, 2M, MZSP. *Ceará*: Aracaty, 1F, MZSP; Barreiras\*, 1M, MZSP; Ceará Beach\*, 5M, 2F, ICCM; Russas, 1M, 1F, MZSP. *Espirito Santo*: 1F, MZSP. *Maranhão*: no locality, 2M, 4F, ICCM; São Luis, 4M, 6F, MZSP. *Matto Grosso*: Pimentel\*, 1M, 2F, MZSP; S. Domingos, 1M, MZSP; Sinop\*, 1F, RRMC. *Pará*: Belem, 1M, MZSP; Cachimbo, 1, IOC; Morroda\*, 1F, ICCM; no locality, 1F, ICCM, Santarem, 2M, 2F, ICCM. *Paraíba*: Coremas, 1M, 2F, MZSP. *Santa Catarina*: Imbituba, 1M, MNRJ.

Peru. Chancayo\*, 2M, MNRJ.

### *Cicindela (Plectographa) nivea* Kirby

Figs. 79, 85, 91, 100, 112

*Cicindela nivea nivea* Kirby, 1818: 376 (TYPE LOCALITY, in Brasilia).—Dejean, 1825: 128.—Horn, 1915: 409; 1926a: 311; 1938: 53.—Fernandez, 1936: 109.—Blackwelder, 1944: 19.—Rivalier, 1954: 266.—Mandl, 1963: 578.—Vidal Sarmiento, 1966b: 41.—Sumlin, 1979: 115.

*Cicindela conspersa* Dejean, 1825: 127 (TYPE LOCALITY, l'île de Sainte-Catherine, au Brésil).—Brullé, 1837: 9.—Horn, 1915: 409; 1926a: 311; 1938: 53.—Barattini, 1929: 1221.—Fernandez, 1936: 109.—Blackwelder, 1944: 19.—Vidal Sarmiento, 1966b: 43.

*Cicindela niver orbigny* Guérin-Ménéville, 1839: 296 (TYPES, a male and female in the MNHP general collection bearing the following labels: "intricata" (green label, on male pin only)/Muséum Paris Patagonie (Patagones) d'Orbigny 1834/ 34 6073" (on a folded round label green on one side)/"TYPE" (black letters on red label); TYPE LOCALITY, la Patagonie).—Horn, 1915: 409; 1926a: 311; 1938: 53.—Fernandez, 1936: 109.—Blackwelder, 1944: 19. Rivalier, 1954: 266.—Vidal Sarmiento, 1966b: 43.—Sumlin, 1979: 115.

*Cicindela intricata* Brullé, 1837: 7 (TYPE LOCALITY, l'île aux Cachons, dans la baie de San-Blas (Patagonie), au bord de la mer).—Horn 1895a: 173; 1926a: 311.—Blackwelder, 1944: 19.—Sumlin, 1979: 115.

*Recognition.*— The character state combination of large body size 9.0-13.5 mm), elytra completely pale or with almost effaced maculations (Figs. 91a, b), dense appressed white setae covering most of the body, and unidentate labrum distinguishes adults of *C. nivea*.

*Description.*— *Body length.* Approximately 9.0-13.5 mm M and F.

*Body colour.* Head and pleuron slightly glossy, coppery and coppery green reflections. Elytra entirely pale or with scattered coppery-green patches. Venter black with coppery or green reflections.

*Body setae.* Dense white appressed setae on head, frons, clypeus, genae, dorsal side of antennal articles 1,3,4 pronotum (mainly front and lateral portions), pleuron, prosternum, lateral portions of metasternum and metacoxae, legs (sparser on tarsus), and abdominal sterna 1-6 (males), 1-5 (females).

*Other external features.* Tooth of mentum long. Labrum unidentate with four to 11 (most commonly eight) submarginal setae (Figs. 79a-c). Pronotum broad, hind angles protruding posteriorly, sutures deep (Figs. 85a-c). Coupling sulcus of mesepisternum of female a deep groove. Apex of front trochanters with one sensory seta, middle trochanters glabrous. Elytra with apices slightly recurved, apical spine obsolete; maculations effaced, ground colour completely absent or diffuse; punctation generally small, few large green

or coppery punctures near shoulder and median suture (Figs. 91a, b); microsculpture irregularly isodiametric; apical serrulations small.

*Female genitalia.* Sternum 8 with shallow V-shaped apical emargination; apices rounded, each with five to seven long thick setae (Figs. 99a, 100a); second gonocoxa with several long and short setae along medial margin (Figs. 99a, 100a); second gonapophyses elongate as in Figures 99a, 100a; syntergum 9 and 10 broadened apically (Figs. 99b, 100b); ventral sclerite lightly sclerotized with posterior lateral projections, median ridge absent (Figs. 99c, 100c); oviduct sclerite wide, with little or no anterior emargination (Figs. 99c, 100c); spermatheca and duct fused to bursa at base, spermatheca and duct ca 3.5-4.0 mm (Figs. 99c, 100c).

*Male genitalia.* Male genitalia have been described by Vidal Sarmiento (1966b: 41).

*Geographical Variation and Subspecies.*— Most adults in northern localities of Brazil have entirely pale elytra; those in southern localities, in Argentina, have elytra with pigmentation forming a diffuse pattern of elytral maculations. Intermediate populations consist of a majority of adults with varying degrees of pigmentation in the elytra. This characteristic seems to be a reasonable basis for the recognition of two subspecies because a north-south irregular cline is evident. The names *C. nivea nivea* and *C. nivea orbignyi* Guérin-Ménéville are retained for northern (Brazil, Uruguay) and southern (Argentina) populations respectively (Fig. 113). The name *C. conspersa*, which was assigned to intermediate forms is not recognized.

*Relationships.*— *Cicindela nivea* and *C. hirsutifrons* (n. Argentina) are sister species.

*Habitat and Period of Activity.*— The activity period is from September to June, though most adults examined were collected in October, November, December, January, and February. Populations are probably found close to sea beaches as indicated by the distribution of the species (Fig. 112).

*Geographical Distribution, Localities, Examined Specimens.*— East coast of South America from Espirito Santo, Brazil south to Patagonia (Fig. 112).

*Cicindela nivea nivea* Kirby, Brazil. *Espirito Santo*: Gurapari, 13M, 6F, MZSP. *Rio de Janeiro*: Atafona, 1M, 1F, MNRJ; Barra de Marua, Praia de Itapuacu\*, 3M, 1F, MZSP; Cidade, 2M, MZSP; Copacabana, 1F, IOC, 2M, 2F, MZSP; Itacuruga\*, 1M, IOC; Leblon, 1M, 5F, MNRJ; Niteroi, 3M, 1F, IOC, 1F, MZSP, 2M, 2F, MNRJ; no locality, 12M, 6F, ICCM; Praia do Sai\*, 1M, 1F, MNRJ; Recreio dos Bandeirantes\*, 1M, 3F, MNRJ; Rio de Janeiro, 1M, 3F, MZSP, 1F, MNRJ; Tijuca, 7M, 4F, MZSP. *Rio Grande do Sul*: Torres, 3M, 1F, MZSP. *Santa Catarina*: Florianopolis, 9M, 3F, MZSP; Itaiaby\*, 1F, MZSP; no locality, 1F, IOC, 4M, MZSP. *São Paulo*: Campos do Jordao, 1M, 3F, MZSP; Iguape, 1F, MZSP; Itanhaem, 1M, 5F, MZSP; Peruibe, 1M, 1F, MZSP; Santos, 3M, 6F, IOC, 2F, MZSP, 1M, 1F, MNRJ; São Vicente, 1M, 3F, MZSP.

Uruguay. Atlantida, 1M, MZSP; Montevideo, 2M, 1F, MZSP.

*Cicindela nivea orbignyi* Guérin-Ménéville. Argentina. *Buenos Aires*: Buenos Aires, 1M, 3F, IOC; La Plata 1F, MZSP.

### The *melaleuca* group

Adults of this group are characterized by eight to fewer than eight submarginal setae on labrum, and very large foveae on elytra. The group has seven species, two of which are found in Brazil, *C. melaleuca* and *C. patagonica*. The geographical range of the *melaleuca* group is centered in northern Argentina and extends

northward to southeastern Brazil, western Paraguay and eastern Bolivia, and southward to temperate Patagonia and Chile. The *melaleuca* and *suturalis* groups are a sister pair.

*Cicindela (Plectographa) melaleuca* Dejean

Figs. 80, 86, 92, 101, 102, 113

*Cicindela melaleuca* Dejean, 1831: 238 (TYPE LOCALITY, près de Buënos-Ayres, sur les bords de la rivière de La Plata, Argentina).—Horn, 1915: 409; 1926a: 310; 1938: 53.—Barattini, 1929: 1219.—Fernandez, 1936: 107.—Blackwelder, 1944: 18.—Rivalier, 1954: 266.—Vidal Sarmiento, 1966b: 40; 1967: 213.—Sumlin, 1979: 110.

*Recognition.*—The character state combination of the very dark brown to black body colour, broad pronotum, (Figs. 86a, b), setose vertex, frons, clypeus and genae, and pattern of elytral maculations (Fig. 92) distinguishes specimens of *C. melaleuca* from other Brazilian tiger beetles.

*Description.*—

*Body length.* ca 8.5-10.5 mm M, ca 9.0-11.0 mm F.

*Body colour.* Head and pronotum slightly glossy, elytra dull. Dorsum very dark brown or black. Pleuron and sternum black with slight reflections of copper, blue, green, and purple. Abdominal sterna black with slight metallic reflections from lateral margins.

*Body setae.* Head with vertex, frons, clypeus, and genae setose. Pleuron generally setose, mesepisternum with a few setae near ventral end. Lateral portions of abdominal sterna 1-5 (females) and 1-6 (males) with appressed setae.

*Other external features.* Labrum elongate, unidentate, almost tridentate, with six to 10 (most commonly eight) submarginal setae (Figs. 80a, b). Pronotum very wide, especially in females, broadened in anterior 0.33 (Figs. 86a, b). Coupling sulcus of mesepisternum of female a straight, long, shallow, broad groove. Apex of front trochanters with one seta. Elytra each with apex recurved to a small spine (Fig. 92). Pattern of elytral maculations with connected humeral lunule and middle band, marginal lunule reduced, apical lunule complete (Fig. 92). Punctuation of elytra green, with a row of large foveae, green-blue with bright coppery umbilicate centers, near median suture and a cluster near shoulder (Fig. 92).

*Female genitalia.* See also Vidal Sarmiento (1967: 209). Sternum 8 with very broad and shallow apical emargination, apices each with five to nine stout setae (Figs. 101a, 102a). Second gonocoxa and second gonapophyses as in Figures 101a, 102a. Syntergum 9 and 10 as in Figures 101b, 102b. Ventral sclerite with two elongate posterior projections (Figs. 101c, 102c). Oviduct sclerite wide (Figs. 101c, 102c). Spermatheca and duct at least 4.5 mm long (broken in dissection).

*Male genitalia.* Male genitalia have been described by Vidal Sarmiento (1966b: 40).

*Geographical Variation.*—Body colour, pattern of the elytral maculations and genitalic characteristics vary considerably in Argentina, and distinct geographical populations occur there. *Cicindela melaleuca* is widespread ranging from Patagonia to Rio Grande do Sul. The *C. reedi* Horn form is a conspecific member or close relative that occurs in Patagonia. Horn (1938: 53) is followed by Sumlin (1979: 111) in treating *C. reedi* as a subspecies of *C. melaleuca* though Rivalier (1954: 266) considers it to be a member of *C. drakei* Horn.

*Relationships.*—*Cicindela melaleuca* and *C. patagonica*, are sister species.

*Habitat and Period of Activity.*—Adults have been found beside salt marshes in Rio Grande do Sul, at the mouth of the Rio de La Plata, and inland in dry areas (Brullé, 1837: 8), in January and February.

*Geographical Distribution, Localities, Examined Specimens.*— Coastal southern Brazil, Uruguay, and Argentina (Fig. 113).

Argentina. *Buenos Aires*: Buenos Aires, 1M, 1F, MZSP.

Brazil. *Rio Grande do Sul*: salt marshes, 3F, ICCM.

Uruguay. Montevideo, 3M, 2F, ICCM, 1F, MNRJ.

*Cicindela (Plectographa) patagonica* Brullé

Figs. 81, 87, 93, 103, 113

*Cicindela patagonica patagonica* Brullé, 1837: 7 (TYPE, a male in the MNHP general collection bearing the following labels: (green disc) "Muséum Paris/Patagonie d'Orbigny/Patagonica/TYPE" (black letters on a red label); TYPE LOCALITY, sur les bords du Rio Negro (Patagonie)). —Horn, 1915: 409; 1926a: 311; 1938: 53.— Barattini, 1929: 1222.— Fernandez, 1936: 108. —Blackwelder, 1944: 19.— Rivalier, 1954: 266.— Vidal Sarmiento, 1966b: 43.— Sumlin, 1979: 114.

*Cicindela patagonica cherubim* Chevrolat, 1858: 315 (TYPE LOCALITY, des environs de Montevideo).—Horn, 1915: 409; 1926a: 311; 1938: 53.— Barattini, 1929: 1222. —Fernandez, 1936: 108.— Blackwelder, 1944: 19.— Rivalier, 1954: 266.— Vidal Sarmiento, 1966b: 43.— Sumlin, 1979: 114.

*Cicindela patagonica bergiana* Horn, 1985a: 174 (TYPE LOCALITY, Montevideo); 1915: 409; 1926a: 311; 1938: 53.— Fernandez, 1936: 108. —Blackwelder, 1944: 19.— Rivalier, 1954: 266.— Sumlin, 1979: 114.

*Recognition.*— The broadly fused pale maculations along lateral margin of the elytron (Figs. 93a, b) combined with a setose clypeus, unidentate labrum bearing seven to nine (eight basic) submarginal setae, large body size (approximately 9.0-10.0 mm), and restricted distribution in southern Rio Grande do Sul distinguish specimens of *C. patagonica* from those of other Brazilian species.

*Description.*—

*Body length.* 9.0 mm M, 10.0 mm F.

*Body colour.* Dorsum ground colour brown. Head, pronotum and elytra with coppery and blue-green reflections.

*Body setae.* Frons and clypeus setose. Pleuron setose. Proepisternum densely setose; setae on lateral margin of abdominal sternites 1-5.

*Other external features.* Labrum unidentate with seven to nine (eight basic) submarginal setae (Figs. 81a, b). Pronotum broad with posteriorly protruding hind angles (Figs. 87a, b). Coupling sulcus of mesepisternum of female a deep groove. Apex of front trochanters with a single seta. Elytra somewhat flattened; apices recurved; apical spine small (Figs. 93a, b). Pattern of elytral maculations broad, continuous along lateral margin, but all lunules present and distinct (Figs. 93a, b). Punctuation sparse and shallow with row of larger punctures along median suture.

*Female genitalia.* No females of *C. p. patagonica* or *C. p. bergiana* were available for study thus only genitalia of *C. p. cherubim* were examined. Sternum 8 with V-shaped emargination, apices broadly rounded each with seven or eight long thick setae (Fig. 103a). Second gonocoxa with long setae on apical end (Fig. 103a). Second gonapophyses with medial and lateral portions of equal length (Fig. 103a). Syntergum 9 and 10 as in Figure 103b. Ventral sclerite of bursa broad and lightly sclerotized, median ridge absent (Fig. 103c). Oviduct sclerite with well developed lateral flanges (Fig. 103c). Length of spermatheca and duct approximately 3.5 mm.

*Male genitalia.* Male genitalia of *C. p. patagonica* and *C. p. cherubim* have been described by Vidal Sarmiento, 1966b.

*Geographical Variation and Subspecies.*— *Cicindela patagonica bergiana* Horn, a brown form, has been recorded from northern Argentina, Uruguay and Rio Grande do Sul, Brazil by Horn (1915: 409), but no details about the latter record were given. *Cicindela p. cherubim* Chevrolat is a green to blue-green form similar to *C. p. bergiana* in the very broad continuous elytral maculations and occupies Uruguay

and the region of northeastern Argentina near Buenos Aires. The nominate form, *C. p. patagonica*, occurs southward to Patagonia.

*Relationships.*— *Cicindela patagonica* and *C. melaleuca* are sister species.

*Habitat and Period of Activity.*— Specimens have been collected in December and February on the seacoast.

*Geographical Distribution, Localities, and Examined Specimens.*— Coastal from Rio Grande do Sul to Patagonia (Fig. 113). The subspecies *C. p. bergiana* occurs in northern most portions of the range.

Argentina. *Buenos Aires*: Buenos Aires, 3M, IOC. *Santa Cruz*: Santa Cruz, 2M, IOC.

Brazil. *Rio Grande do Sul*: no locality, 1M, BMNH.

Uruguay. Aramincla, 1F, MNRJ; Cuchilla Alta, 1M, MNRJ; Montevideo, 2F, IOC, 3F, MZSP; Rocha, 1F, MNRJ.

#### The *nigrovittata* group

Adults of this group are characterized by deep rugosity in form of two swirls on head between the eyes. The group has only one species, *C. nigrovittata*, which is found in the Brazilian Highlands. Phylogenetic relationships of the *nigrovittata* group are uncertain.

#### *Cicindela (Plectographa) nigrovittata* Horn

Figs. 82, 88, 94, 104, 109, 114

*Cicindela nigrovittata* Horn, 1896c: 172 (SYNTYPES, two females and one male in the IPZE labelled: "Nonfried Minas Geraes/Type ! Dr. W. Horn (1M 1F), Type ! Coll. W. Horn (1F)/Syntypes" (black letters on red label); TYPE LOCALITY, Minas Geraes); 1915: 405; 1926a: 307; 1938: 52.—Blackwelder, 1944: 19.

*Recognition.*— The character state combination of the large body size, black body colour, large deep punctures with sharp edges in the anterior 0.5 of the elytra (Fig. 94) and pronotum (Fig. 88), and one or two small pale spots, and velvety patterns on the elytra (Fig. 94) distinguish adults of *C. nigrovittata* from those of other Brazilian species of *Cicindela*. The female genitalia are diagnostic (Figs. 104a-c).

#### *Description.*—

*Body length.* ca 7.5 mm M, ca 8.0-9.0 mm F.

*Body colour.* Dorsum dull, black, matte and velvety patterns on the elytra. Venter slightly glossy, black faint purple reflections from proepisternum and mesepisterna. Legs black, with hint of coppery and green reflections.

*Body setae.* Fine sparse white pubescence present on: vertex, frons, and genae of head; all margins and beside longitudinal suture of pronotum, pleuron, and lateral portions of abdominal sterna 1-5. Few short fine setae arise from deep punctures on basal end of elytra.

*Other external features.* Vertex of head deeply rugose. Two wide pits on vertex between hind margins of eyes. Tooth of mentum elongate, well developed. Preapical articles of labial palpi broad. Labrum convex, elongate, tridentate, with four to six submarginal setae (Fig. 82). Pronotum broadened anteriorly, sides not rounded; large, deep punctures on lateral portions (Fig. 88). Coupling sulcus of mesepisternum of female shallow, wide, virtually absent. Apex of front trochanters with one seta. Elytra broadened in apical 0.33; apices slightly recurved to small spine (Fig. 94). Pattern of elytral maculations with one or two small pale

spots, and velvety and matte motif (Fig. 94). Punctures of elytra large, deep, with sharp edges (not raised) in basal 0.33, shallow and indistinct in apical 0.66 (Fig. 94). Microsculpture of elytra basically isodiametric, unclear in matte areas. Apices of elytra almost smooth, microserrulations tiny.

*Female genitalia.* Sternum 8 with deep moderately wide apical emargination, each apex with five stout setae (Fig. 104a). Second gonocoxa with two or three setae on medial margin (Fig. 104a). Second gonapophyses elongate (Fig. 104a). Syntergum 9 and 10 as in Figure 104b. Bursa copulatrix with pair of lateral extensions (Fig. 104c). Ventral sclerite of bursa with two lateral posterior projections (Fig. 104c). Oviduct sclerite small, shield-shaped (Fig. 104c). Spermatheca and duct at least 2.0 mm long (broken in dissection).

*Male genitalia.* Median lobe stout, apex short slightly curved ventrally (Figs. 109a, b). Internal sac with flagellum 1.5 loops at base. Tooth dark elongate, narrow, spatulate apex; stylet absent. Small stiffening rib present; shield small. Arciform piece broad; central plate square-shaped at its base; right bar narrow (Figs. 109a-d).

*Geographical Variation.*— The pale spots on the elytra vary from one to two, and the extent of the velvety pattern on the elytra differs in the few specimens examined. A geographical pattern in these characteristics is not evident.

*Relationships.*— *Cicindela nigrovittata* is not closely related to any other species of subgenus *Plectographa*.

*Habitat and Period of Activity.*— Unknown.

*Geographical Distribution, Localities, Examined Specimens.*— Inland (Fig. 114).

Brazil. *Minas Gerais*: Nonfried\*, 1M, 2F (syntypes), IPZE; San Antonio Barranca\*, 1F, IPZE.

#### The *apiata* group

Adults of this group are characterized by stylet tooth long and pointed, and shield reduced or absent from the internal sac of the male. The group has two species, of which one, *C. apiata*, is found in Brazil. The geographical range of the *apiata* group is centered in northern Argentina and extends northward to the Brazilian Highlands. The *apiata* group is relatively primitive and not closely related to other groups in subgenus *Plectographa*.

#### *Cicindela (Plectographa) apiata* Dejean

Figs. 83, 89, 95, 105, 106, 110, 111, 114

*Cicindela apiata apiata* Dejean, 1825: 86 (TYPE LOCALITY, la partie meridionale du Brésil).— Bruch, 1907: 123.— Horn, 1915: 408; 1926a: 310, 1938: 52.— Varas Arangua, 1925: 37.— Barattini, 1929: 1217.— Fernandez, 1936: 107.— Blackwelder, 1944: 16.— Rivalier, 1954: 266.— Vidal Sarmiento, 1966a: 256, 259; 1966b: 39.— Sumlin, 1979: 114.

*Cicindela apiata clausseii* Putzeys, 1845: 365 (TYPE LOCALITY, la province des Mines au Brésil).— Horn, 1915: 408; 1923: 111; 1926a: 310; 1938: 52.— Blackwelder, 1944: 16.— Rivalier, 1954: 266.— Vidal Sarmiento, 1966b: 39.

*Recognition.*— Adults of *C. apiata* are set apart from those of other Brazilian species by a combination of the broad elytral maculations lacking a marginal band (Figs. 95a-d), narrow unidentate labrum with seven to 13 submarginal setae (Figs. 83a-d), and structure of female genitalia (Figs. 105, 106). The male genitalia are also specific (Figs. 110, 111, and Vidal Sarmiento, 1966b: 33, 39).



*Synonyms.*— Names were based upon comparison of specimens on loan with original descriptions.

*Description.*—

*Body length.* 7.0-9.5 mm M, 7.5-9.5 mm F.

*Body colour.* Dorsum dull, dark brown. Head and pronotum greenish in some specimens. Pleuron and lateral edges of abdomen mainly coppery. Venter black with blue-green reflections.

*Body setae.* Pleuron moderately setose. Mesepisternum sparsely setose near coxa. Lateral portions of abdominal sterna 1-6 (males) and 1-6 or 1-5 (females) setose.

*Other external features.* Labrum unidentate, tooth prominent or obscurely tridentate, seven to 13 submarginal setae (Figs. 83a-d). Pronotum stout broader in anterior 0.5, sides slightly to strongly ampliate (Figs. 89a-d). Coupling sulcus of mesepisternum of female a broad groove. Apex of front trochanters with one seta. Profemora and mesofemora with very long fine setae. Apices of elytra not recurved, obliquely truncated to tapered, apical spine small. Elytra with maculations broad, with or without ragged edges and appearing as spots or not. Humeral lunule complete, oblique joined or not to complete middle band, apical lunule complete and separate, marginal band absent (Figs. 95a-d). A few setae present or not on shoulder of elytra. Punctuation green, sparse with larger umbilicate punctures near shoulder and along median suture. Microsculpture isodiametric bead-like.

*Female genitalia.* Sternum 8 with moderately deep V-shaped posterior emargination, apices each with three to five stout setae (Figs. 105a, 106a). Second gonocoxa with a few setae on medial margin (Figs. 105b, 106a). Second gonapophyses as in Figures 105a, 106a. Syntergum 9 and 10 elongate, broadened apically (Figs. 105b, 106b). Ventral sclerite of bursa copulatrix with two posterior lateral extensions (Figs. 105c, 106c). Lateral flanges of oviduct sclerite well developed (Figs. 105c, 106c). Spermatheca and duct *ca* 2.5 mm long.

*Male genitalia.* Apex of median lobe with small projection (Figs. 110a, b, 111a, b). Internal sac with flagellum 1.5 loops at base. Stylet and tooth both very long and pointed. Right bar and small stiffening rib present; arciform piece moderately wide (Figs. 111c, d and Vidal Sarmiento, 1966b: 33, 39).

*Geographical Variation and Subspecies.*— Adults of *C. apiata* are varied in body size, in presence or absence of setae on the clypeus, in number of submarginal setae on the labrum, in shape of pronotum, in the pattern of elytral maculations, in presence or absence of setae on the base of elytra; and in presence or absence of setae on sternum 6 of females. Although the specimens used in this study were too few for statistical analysis, the sparse data assembled indicate geographical patterns in the variation of these characteristics.

The body length of *C. apiata* varies from 7.0-7.5 (male) and 7.5-8.0 mm (female) in Rio de Janeiro to 9.0-9.5 mm (male) and 9.5 mm (female) in Rio Grande do Sul. In Brazil an uneven southward increase in adult body length is evident with an abrupt change in Rio Grande do Sul. A east-west pattern of variation in body length is not apparent. Adults of both sexes from Argentina are the largest being *ca* 9.0-10.0 mm long.

Variation in the other observed characteristics roughly complements that of body length. Most large specimens have a pronotum with ampliate sides, glabrous clypeus, bear fewer submarginal setae on the labrum (7-8 for males, 8 for females in Rio Grande do Sul; 10 for males, 9 for females in Rio de Janeiro), lack setae on the base of elytra, and they have expanded elytral maculations with ragged and spotted edges particularly in the humeral lunule and marginal band which are connected or almost connected. Females lack setae on the lateral margins of abdominal sternum 6.

In contrast, most small specimens have a less stout pronotum with only slightly ampliate sides, bear setae on the clypeus, (usually 2, crossed), have a greater number

of submarginal setae on the labrum (eight or nine for males, 11-12 for females in Rio de Janeiro; 11 for males, 13 for females in São Paulo), bear setae on the base of the elytra, and have narrower elytral maculations with even edges and generally unspotted with unconnected humeral lunule and middle band. Females have a few setae on the lateral margins of abdominal sternum 6.

Because there is a considerable amount of concordant variation among these characteristics two subspecies are recognized, *C. apiata apiata* and *C. apiata clausenii*. The former comprises relatively large adults, most of which have a glabrous clypeus, labrum with seven to 10 (males) and eight or nine (females) submarginal setae (Figs. 83a,b), broad pronotum with ampliate sides (Figs. 89a,b), expanded, merged, ragged and spotted elytral maculations (Figs. 95a, b), and glabrous base of elytra and lateral margin of abdominal sternum 6; the female genitalia are as in Figures 105a-c. Adults of the latter subspecies are smaller, most of which have one or two setae on the clypeus, labrum with eight to 11 (males) and 11-13 (females) submarginal setae (Figs. 83c, d), pronotum with sides not noticeably ampliate (Figs. 89c, d), and elytral maculations relatively narrow, with an even outline, isolated maculations, and few spots (Figs. 95c, d), and a few setae on the base of elytra and lateral margin of abdominal sternum 6. Female genitalia are as in Figures 106a-c.

The subspecies *C. a. apiata* ranges from the northern half of Argentina and Uruguay north to Rio Grande do Sul, Matto Grosso, São Paulo, Minas Gerais and Rio de Janeiro, while *C. a. clausenii* occurs in Matto Grosso, São Paulo, Minas Gerais, and Rio de Janeiro (Fig. 114). Adults with characteristics of both subspecies are present in Rio de Janeiro.

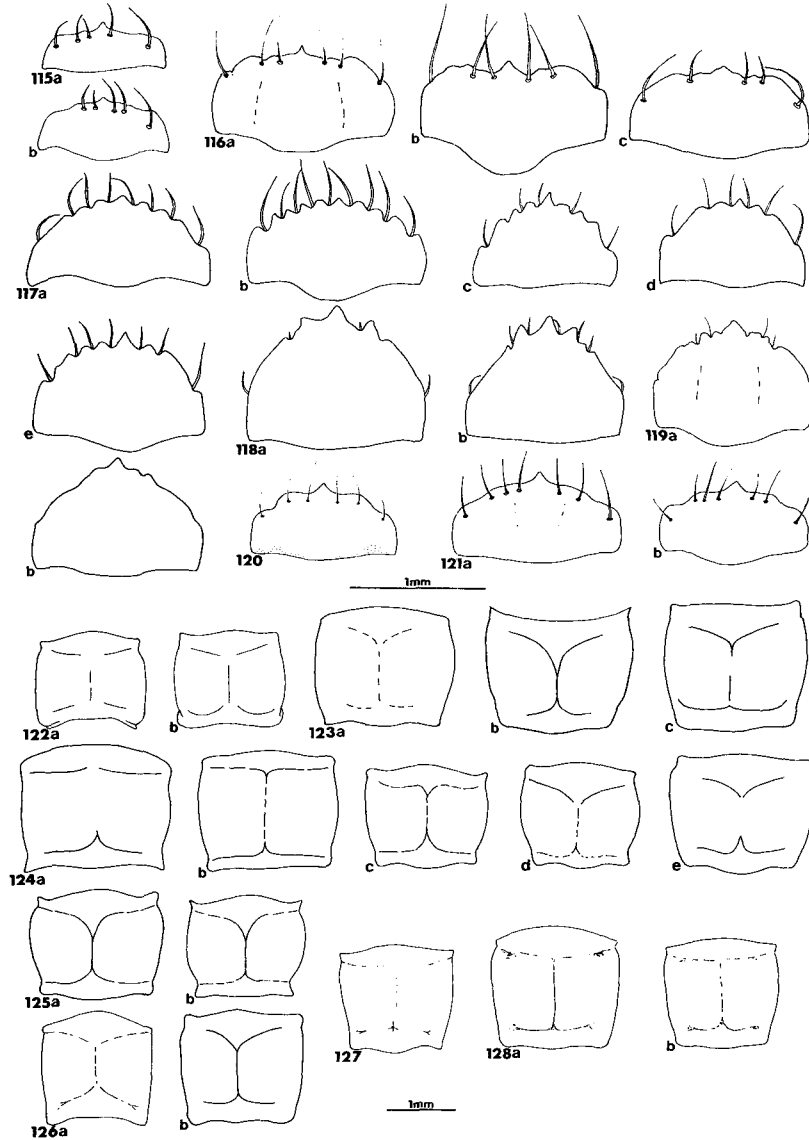
*Relationships*.— *Cicindela apiata* and *C. eugeni* Castelnau (n. Argentina) are sister species.

*Habitat and Period of Activity*.— Adults have been collected from October to May, beside water, at various elevations from sea level to 1700 m. Adults of *C. a. apiata* have been found near salt marshes.

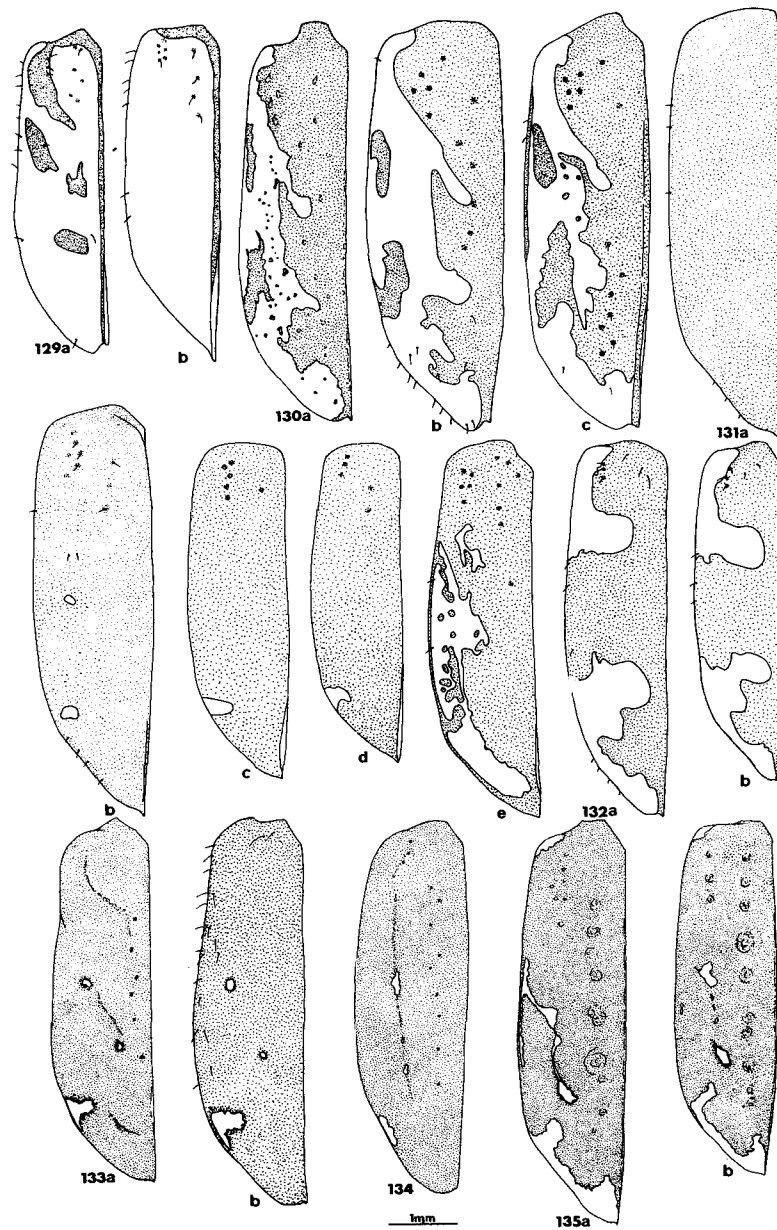
*Geographical Distribution, Localities, Examined Specimens*.— Coastal and inland, from the northern half of Argentina north to Rio Grande do Sul, São Paulo, Matto Grosso, Minas Gerais, and Rio de Janeiro (Fig. 114).

*Cicindela apiata apiata* Dejean. Brazil. *Matto Grosso*: Salobra, 1M, MZSP; Três Lagoas, 5M, MZSP; Vacaria, 1M, 1F, MZSP. *Minas Gerais*: Mar de Espanha\*, 2F, IOC, 1M, 1F, MZSP; Passa Quatro, 1M, 2F, IOC. *Rio de Janeiro*: Campo Bello\*, 1F, MZSP; Itatiaia (700-1110m), 2M, 7F, IOC; Rio de Janeiro, 1M, 1F, MZSP. *Rio Grande do Sul*: salt marshes, 4M, 1F, ICCM. *São Paulo*: Campos do Jordao, 1M, 3F, MZSP; Cantareira\*, 1M, MZSP; Garca, 6M, 1F, MZSP; Onda Verde\*, 2F, MZSP; Pindamonhangaba, 1M, 1F, MZSP.

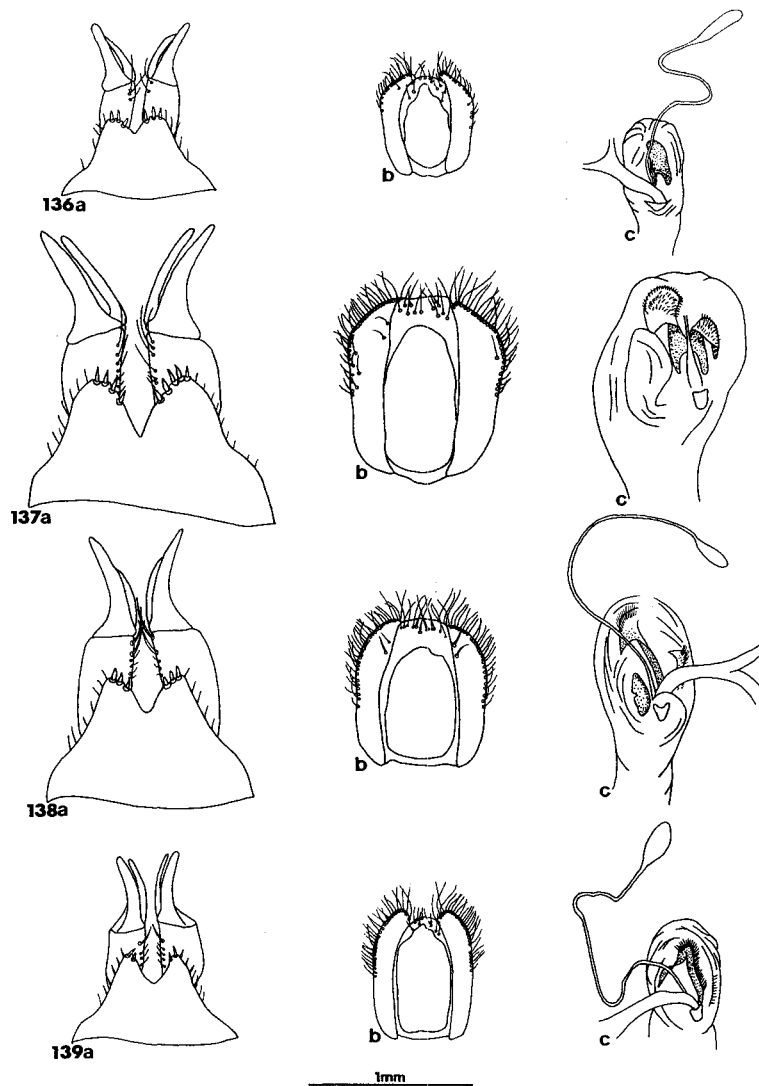
*Cicindela apiata clausenii* Putzeys. Brazil. *Matto Grosso*: Vacaria, 4M, 4F, MZSP. *Minas Gerais*: Caraga\*, 1M, IOC; Pocos de Caldas, 12 ♀, RRM: Virginia (1500 m), 1M, MNRJ. *Rio de Janeiro*: Grajau, 1M, 1F, IOC; Itatiaia, 1M, 1F, MNRJ; Petropolis, 1M, MNRJ; no locality, 3M, 2F, ICCM. *São Paulo*: Alto da Serra (mountains between São Paulo and Santos), 5M, 6F, MZSP; Serra do Bocaina\*, 7M, 4F, MNRJ.



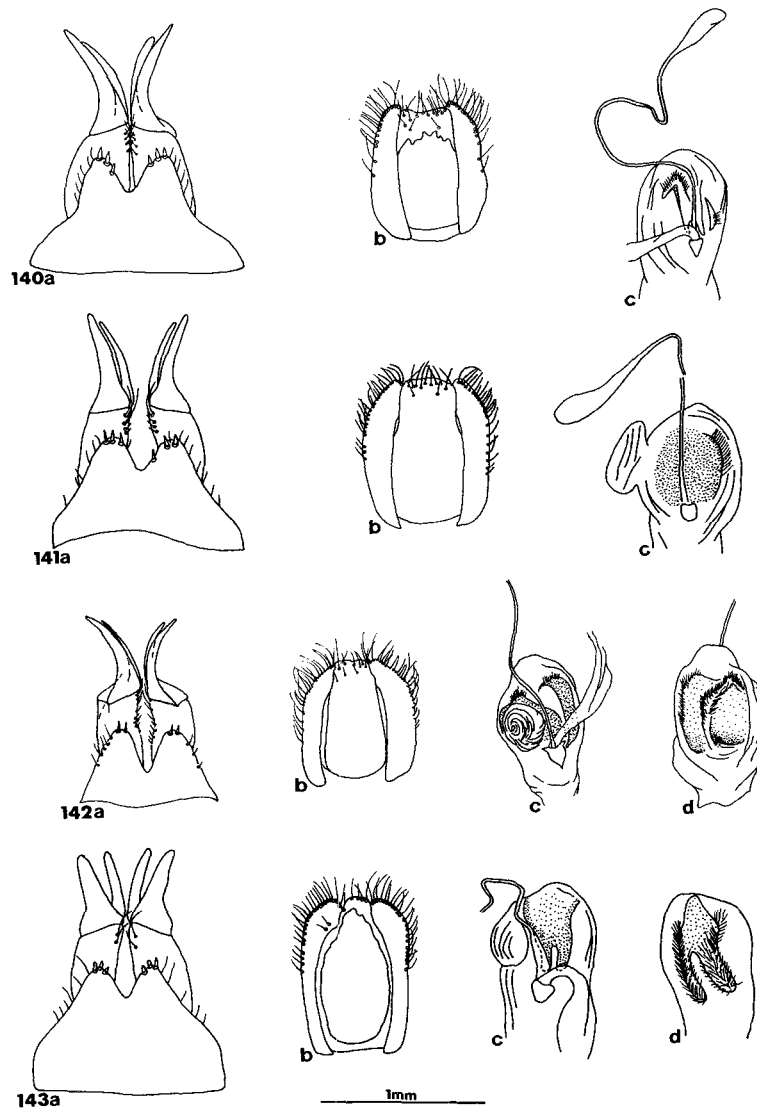
Figs. 115–121. Labrum, dorsal aspect: 115, *Cicindela kollari* Gistl, Santa Teresina, M. Grosso: (a) female; (b) male; 116, *C. confluentesignata* Horn: (a) female, Minas Gerais; (b) female, (c) male, Rivera, Uruguay; 117, *C. morio* Klug: (a) female, (b) male, Jatai, Go.; (c) female, (d) male, Dianopolis, Go.; (e) female, Pará; 118, *C. marquardtii* Horn, Três Lagoas, M. Grosso: (a) female; (b) male; 119, *C. piligera* Horn: (a) male, Minas Gerais; (b) female, Ecuador; 120, *C. obsoletesignata* Horn, male, Santa Catarina; 121, *C. friedenreichi* Dokhtoureff, Rio Grande do Sul: (a) female; (b) male. Figs. 122–128. Pronotum, dorsal aspect. 122, *Cicindela kollari* Gistl, Santa Teresina, M. Grosso: (a) female; (b) male; 123, *C. confluentesignata* Horn: (a) female, Minas Gerais; (b) female, (c) male, Rivera, Uruguay; 124, *C. morio* Klug: (a) female, (b) male, Jatai, Go.; (c) female, (d) male, Dianopolis, Go.; (e) female, Pará; 125, *C. marquardtii* Horn, Três Lagoas, M. Grosso: (a) female; (b) male; 126, *C. piligera* Horn: (a) male, Minas Gerais; (b) female, Ecuador; 127, *C. obsoletesignata* Horn, male, Santa Catarina; 128, *C. friedenreichi* Dokhtoureff, Rio Grande do Sul: (a) female; (b) male.



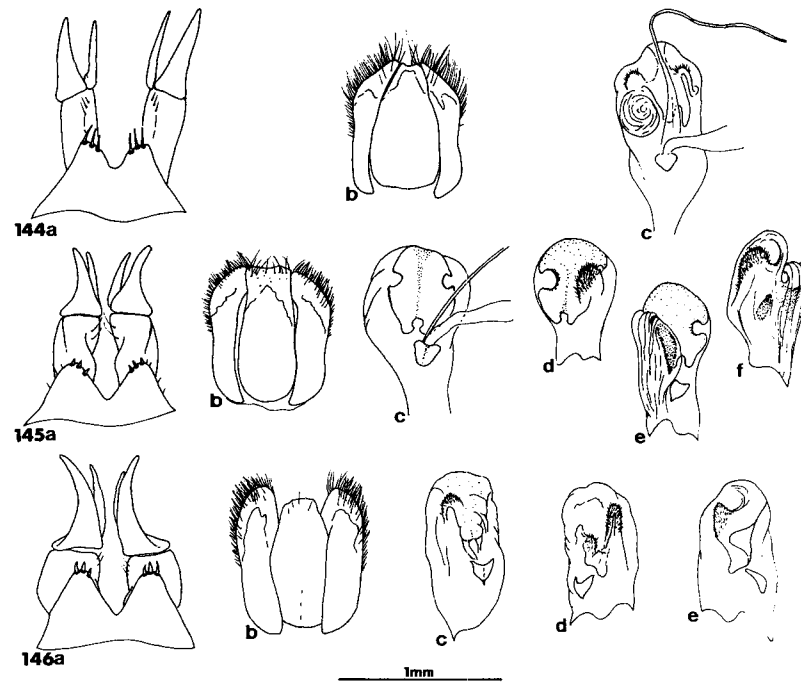
Figs. 129–135. Elytron, dorsal aspect. 129, *Cicindela kollari* Gistel, Santa Teresina, M. Grosso: (a) female; (b) male; 130, *C. confluentesignata* Horn: (a) female, Minas Gerais; (b) female, (c) male, Rivera, Uruguay; 131, *C. morio* Klug: (a) female, (b) male, Jatai, Go.; (c) female, (d) male, Dianópolis, Go.; (e) female, Pará; 132, *C. marquardtii* Horn, Três Lagoas, M. Grosso: (a) female; (b) male; 133, *C. piligera* Horn: (a) male, Minas Gerais; (b) female, Ecuador; 134, *C. obsoletesignata* Horn, male, Santa Catarina; 135, *C. friedenreichi* Dokhtoureff, Rio Grande do Sul: (a) female; (b) male.



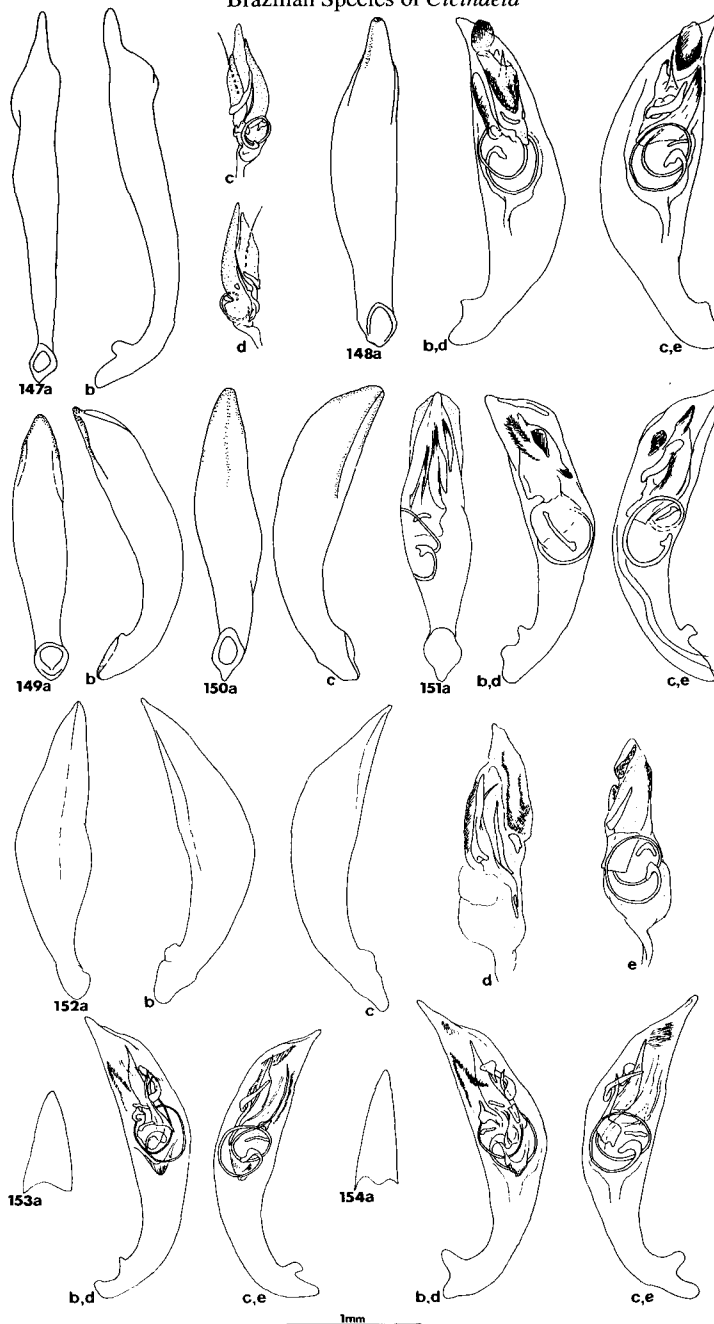
Figs. 136–139. Female genitalia: (a) sternum 8, second gonocoxa, second gonapophyses, ventral aspect; (b) syntergum, 9 & 10, dorsal aspect; (c) bursa copulatrix, oviduct sclerite, oviduct, spermatheca and duct, ventral sclerite, ventral aspect. 136, *Cicindela kollari* C., Santa Teresina, M. Grosso; 137, *C. confluentesignata* Horn: Rivera, Uruguay; *C. morio* Klug: 138, Dianópolis, Go.; 139, Dianópolis, Go.;



Figs. 140–143. Female genitalia: (a) sternum 8, second gonocoxa, second gonapophyses, ventral aspect; (b) syntergum, 9 & 10, dorsal aspect; (c) bursa copulatrix, oviduct sclerite, oviduct, spermatheca and duct, ventral sclerite, ventral aspect; (d) dorsal aspect. *Cicindela morio* Klug: 140, Pará; *C. marquardtii* Horn: 141, Três Lagoas, M. Grosso; 142, Matto Grosso or São Paulo (syntype); *C. piligera* Horn: 143, Ecuador.



Figs. 144–146. Female genitalia: (a) sternum 8, second gonocoxa, second gonapophyses, ventral aspect; (b) syntergum, 9 & 10, dorsal aspect; (c) bursa copulatrix, oviduct sclerite, oviduct, spermatheca and duct, ventral sclerite, ventral aspect; (d) dorsal aspect; (e) left lateral aspect; (f) right lateral aspect. 144, *Cicindela piligera* Horn, Minas Gerais; 145, *C. obsoletesignata* Horn, Santa Catarina; 146, *C. friedenreichi* Dokhtoureff, Rio Grande do Sul.



Figs. 147–154. Male genitalia: (a) dorsal aspect (apex only in some specimens), (b) right lateral aspect, (c) left lateral aspect; internal sac, arciform piece, central plate, flagellum, right bar, small stiffening rib, stylet, tooth, (d) right lateral aspect, (e) left lateral aspect. 147, *Cicindela kollari* Gistel, Santa Teresina, M. Grosso; *C. morio* Klug: 148, Jatai, Go.; 149, Dianopolis; *C. marquardtii* Horn: 150, Três Lagoas, M. Grosso; 151, Matto Grosso or São Paulo (syntype); 152, *C. piligera* Horn, Minas Gerais; 153, *C. obsoletesignata* Horn, Santa Catarina; 154, *C. friedenreichi* Dokhtouroff, Rio Grande do Sul.





Fig. 155. Map showing the geographical distribution of the species *Cicindela kollari* Gistl (■), and *C. confluentesignata* Horn (●). Open squares and circle represent state records of *C. kollari* Gistl and *C. confluentesignata* Horn respectively.



Fig. 156. Map showing the geographical distribution of the species *Cicindela morio* Klug (●), and *C. marquardtii* Horn (■). Open circle represents a state record for *C. morio* Klug.



Fig. 157. Map showing the geographical distribution of the species of *Cicindela friedenreichi* Dokhtouroff (▲). Open circles and squares represent state or country records for *C. piligera* Horn and *C. obsoletesignata* Horn respectively.

Subgenus *Cylindera* Westwood

Genus *Cylindera* Westwood, 1831: 300 (TYPE SPECIES, *Cicindela germanica* Linnaeus, by original designation).—Horn, 1915: 236, 245 and 291. —Rivalier, 1954: 264.—Reichardt, 1977: 374.

Genus *Cicindosa* Motschulsky, 1864: 173 (TYPE SPECIES, *Cicindosa obliquealba* Motschulsky, by original designation).—Horn, 1915: 236, 405.—Reichardt, 1977: 374. NEW SYNONYMY.

*Recognition*.— Adults of this subgenus are distinguished by the five characters given in couplet 5 of the key. In addition the labrum has 5-13 submarginal or marginal setae; elytral maculations are broad in specimens of most species, extensive in specimens of a few species, and absent in others; apex of the median lobe of the male is not hooked; females of most species have a bursa copulatrix with a well developed ventral sac, and ventral sclerite with two anterior lobes and posterior projections covered with setae; the spermatheca and duct together are approximately 1.7-3.0 mm long.

*Species Groups*.— This subgenus has two South American species groups, *morio* group and *friedenreichi* group, which together have nine species. Both groups are found in Brazil.

*Geographical Distribution*.— The geographical range of this subgenus extends from northern Argentina northward to the Amazon River.

*Phylogenetic Relationships*.— *Cylindera* and *Plectographa* are sister subgenera.

The *morio* group

Adults of this group are characterized by a broad pronotum and membranous tooth in the internal sac of the male. The group has six species, four of which are found in Brazil, *C. kollari*, *C. confluentesignata*, *C. morio*, and *C. marquardtii*. The geographical range of the *morio* group extends from eastern Brazil to eastern Peru and Ecuador, and southern parts of the Amazon basin. The *morio* group and *friedenreichi* group are a sister pair.

*Cicindela (Cylindera) kollari* Gistel

Figs. 115, 122, 129, 136, 147, 155

*Cicindela hirticollis* Dejean, 1831: 256 (not Say) (TYPE LOCALITY, au Brésil).— Gistel, 1837: 64.— Horn, 1915: 404; 1926a: 306.— Blackwelder, 1944: 18.

*Cicindela kollari* Gistel, 1837: 64 (TYPE LOCALITY, circa Pará in Brasilia).— Horn, 1915: 404; 1926a: 306; 1938: 52. —Blackwelder, 1944: 18.— Rivalier, 1954: 265.

*Cicindela scutellaris* Gistel, 1837: 87 (not Say) (TYPE LOCALITY, in Brasilia).— Horn, 1915: 404, 1926a: 306.— Blackwelder, 1944: 18.

*Cicindela dimidiaticornis* Lucas, 1857: 30 (TYPE LOCALITY, le Brésil intérieur).— Horn, 1915: 404; 1926a: 306.—Blackwelder, 1944: 18.

*Recognition*.— The character state combination of the dark head and pronotum contrasting with the paler elytra, antenna with pale articles 5-11, unidentate short labrum with 5 or 6 submarginal setae (Figs. 115a, b), single seta on the front and middle trochanters, widely expanded elytral maculations (Figs. 129a, b), and large

and deep brown punctures of the elytra distinguishes adults of *C. kollari* from those of other Brazilian species of *Cicindela*.

Adults of *C. kollari* are similar to those of its Peruvian sister species of *C. malaris* Horn which is found in the area of the upper Amazon River system from Pampa del Sacramento to Pebas. Adults of *C. malaris* have a distinct pattern of elytral maculations with large patches of dark colour. Males have appressed white setae on the margins of sterna 1-6. Adults of *C. kollari* have almost or completely immaculate elytra, and males have margins of abdominal sterna 1-5 setose.

*Synonyms and Types*.— The name *C. dimidiaticornis* was assigned to male of *C. kollari* (see Geographical Variation and Sexual Dimorphism section).

*Description*.—

*Body length*. ca 6.8-7.0 mm M, ca 6.5 mm F.

*Body colour*. Head green, coppery and purple (especially females). Pronotum coppery and green. Elytra, mainly ivory, with brown punctation, dark brown patches with hint of blue-green reflections in females. Venter dark brown coppery and green reflections.

*Body setae*. Males more densely setose than females. Head glabrous. Pronotum margins densely setose; disc sparsely setose. Pleuron densely setose, mesepisternum with a few setae near mesocoxa. Lateral portions of abdominal sterna 1-5 in males, 1-6 in females, metasternum and metacoxa with dense appressed setae.

*Other external features*. Antennal articles 5-11 pale. Labrum narrow (not elongate), unidentate, five or six submarginal setae (Figs. 115a, b). Pronotum square, hind angles of females protruded (Figs. 122a, b). Coupling sulcus of mesepisternum of female an elongate straight groove. Legs, especially the femur, more densely setose in males. Apices of front and middle trochanters each with one seta. Apex of elytra recurved to small spine in females, not recurved elongated to long spine in males (Figs. 129a, b). Dark portions of colour pattern almost effaced or effaced in males (Fig. 129b), patches of dark ground colour indicate oblique humeral lunule and middle band in females (Fig. 129a). Punctures of elytra large, deep, and brown, a few large punctures near shoulder and median suture in basal 0.33. Microsculpture of elytra almost effaced.

*Female genitalia*. Sternum 8 with shallow, broad, V-shaped apical emargination, apices broadly rounded each with three stout setae (Fig. 136a). Second gonocoxa with several setae on median margin (Figs. 136a). Second gonapophyses as in Figure 136a. Syntergum 9 and 10 as in Figure 136b. Ventral sclerite lightly sclerotized with lateral lobes extending posteriorly (Fig. 136c). Oviduct sclerite short and wide (Fig. 136c). Spermatheca and duct ca 1.7 mm long.

*Male genitalia*. Median lobe tapered apically (Figs. 147a, b). Internal sac with flagellum 1.5 loops at base. Tooth mainly dark elongate membranous field with small sclerite at base. Right bar, stylet and small stiffening rib well developed; shield membranous. Arciform piece moderately wide; central plate lightly sclerotized (Figs. 147c, d).

*Geographical Distribution and Sexual Dimorphism*.— Insufficient material was available to determine patterns of geographical variation, however, within populations sexual dimorphism occurs. Males have dense body pubescence, non-protruding hind angles of pronotum, almost effaced or completely effaced colour pattern of elytra, and elongate, not recurved, apices of elytra. Females have moderately pubescent bodies, protruding hind angles of pronotum, elytra with extensive patches of dark ground colour and recurved apices.

*Relationships*.— *Cicindela kollari* and *C. malaris* Horn (Peru) are tentative sister species.

*Habitat and Period of Activity*.— Adults have been collected in August on the Matto Grosso side of Rio Araguaia, Santa Isabel. Habitat unknown.

*Geographical Distribution, Localities, Examined Specimens.*— **Central Brazil** (Fig. 155).

Brazil. *Goiás*: no locality, 3!, MNHP. *Matto Grosso*: Santa Isabel, 1M, CASC; Santa Teresina, 1M, 2F, CASC. *Pará*: no locality, 1M, ICCM.

*Cicindela (Cylindera) confluentesignata* Horn

Figs. 116, 123, 130, 137, 155

*Cicindela confluens* Horn, 1893: 197 (not Bremsi, Fowler, Kraatz); 1894: Pl. 3, Fig. 6.— Blackwelder, 1944: 17.

*Cicindela confluentesignata* Horn, 1915: 407 (replacement name) (HOLOTYPE, a female in the IPZE collection bearing the following labels: "Minas Geraes, Staudinger/Type ! Dr. W. Horn/Holotypus (black letters on red label)"/"*Cicindela confluens* Horn"; TYPE LOCALITY, Minas Geraes); 1926a: 309; 1938: 52.— Fernandez, 1936: 106.— Blackwelder, 1944: 17.— Rivalier, 1954: 265.— Vidal Sarmiento, 1966a: 259; 1966b: 33, 38.— Mandl, 1973: 296 (*Brasiliella*).— Sumlin, 1979: 105.

*Recognition.*— The character state combination of pattern of elytral maculations (Figs. 130a-c) and the shape of the labrum with its nearly marginal five or six setae (Figs. 116a-c) distinguishes adults of *C. confluentesignata* from other Brazilian species of *Cicindela*.

*Synonyms and Types.*— Horn (1915: 407) designated the name *C. confluentesignata* for the name *C. confluens* Horn preoccupied by *C. confluens* Kraatz.

*Description.*—

*Body length.* 8.5 mm M, 8.5-9.0 mm F.

*Body colour.* Dorsum slightly glossy; head and pronotum black or dark brown with coppery green reflections; elytra coppery brown with coppery and green reflections and with a few large green punctures. *Venter and pleuron* glossy, black with blue-green and coppery reflections.

*Body setae.* Genae with a few setae. Proepisternum moderately setose; mesepisternum with a few setae near ventral end; metepisternum setose. Abdominal sterna 1-6 setose laterally.

*Other external features.* Antenna with articles 5-11 pale. Labrum convex, basically unidentate but can be up to seven dentate, with five or six marginal setae (Figs. 116a-c). Pronotum stout widest in front 0.5 (Figs. 123a-c). Coupling sulcus of mesepisternum of female a long and narrow groove. Apex of front trochanters each with one seta. Elytra with apices recurved to a short spine; maculations broad and more or less continuous; large and small punctures with green reflections (Figs. 130a-c).

*Female genitalia.* Sternum 8 with sharp V-shaped emargination in apical end; apices with four or five stout setae of moderate length (Fig. 137a). Second gonocoxa with setae along median margin (Fig. 137a); second gonapophyses narrow and elongate (Fig. 137a); syntergum 9 and 10 as in Figure 137b; ventral sclerite lightly sclerotized with two lateral extensions directed posteriorly, and two anterior flaps covered with brown setae (Fig. 137c); oviduct sclerite small, rectangular (Fig. 137c); spermathecal duct broken, length unknown.

*Male genitalia.* The male genitalia have been described by Vidal Sarmiento (1966b: 33, 38).

*Geographical Variation.*— There is local and geographical variation in the pattern of elytral maculations (Figs. 130a-c) and in the shape of the labrum (Figs. 116a-c). Distinct geographical patterns are unclear.

*Relationships.*— *Cicindela confluentesignata* and *C. granulipennis* Bates (Ecuador) are tentative sister species.

*Habitat and Period of Activity.*— Adults have been collected in November and January. Habitat unknown. This species may be riparian.

*Geographical Distribution, Localities, Examined Specimens.*— The species *C. confluentesignata* ranges from Minas Gerais south to Uruguay, northern Argentina and Paraguay (Fig. 155).

Brazil. *Minas Gerais*: no locality, 1F (holotype), IPZE. *Rio Grande do Sul*: Pelotas, 1F, MNRJ. Uruguay. Durazno, 1M, MNRJ; Rivera, 1M, 3F, MNRJ; Tacuarembó, 1M, MNRJ.

*Cicindela (Cylindera) morio* Klug

Figs. 117, 124, 131, 138, 139, 140, 148, 149, 156

*Cicindela denticulata* Klug, 1834: 15 (TYPE LOCALITY, aus Brasilien).— Horn, 1892b: 213; 1915: 405; 1923: 112; 1926a: 307; 1938: 52.—Blackwelder, 1944: 18.—Rivalier, 1954: 265.

*Cicindela morio* Klug, 1834: 16 (TYPE LOCALITY, aus Brasilien).— Horn, 1892b: 213; 1915: 405; 1926a: 307; 1938: 52.—Blackwelder, 1944: 18.—Rivalier, 1954: 265.—Vidal Sarmiento, 1966a: 259; 1966b: 27.—Sumlin 1979: 108.

*Cicindela ocskayi* Gistel, 1837: 22 (TYPE LOCALITY, in Brasilia).— Horn, 1915: 405; 1926a: 307.—Blackwelder, 1944: 18.

*Cicindela acompso* Chaudoir, 1852: 27 (TYPE LOCALITY, les bords du fleuve des Amazones); 1854: 122.—Horn, 1915: 405; 1926a: 307; 1938: 52.—Blackwelder, 1944: 18.

*Cicindela egena* Chaudoir, 1854: 123 (TYPE LOCALITY, les contrées riveraines du fleuve des Amazones).—Horn, 1915: 405; 1926a: 307.—Blackwelder, 1944: 18.

*Cicindosa obliquealba* Motschulsky, 1864: 173 (TYPE LOCALITY, Des rives du fl. des Amazones).—Horn, 1915: 405; 1926a: 307.—Blackwelder, 1944: 18.

*Cicindosa inaequalis* Motschulsky, 1864: 174 (TYPE LOCALITY, De l'Amérique équatoriale).—Horn, 1915: 405; 1926a: 307.—Blackwelder, 1944: 18.

*Recognition.*— The character state combination of the elongate, convex, and 7-12 dentate labrum (Figs. 117a-e), black body, pattern of elytral maculations (Figs. 131a-e), and structure of male and female genitalia distinguishes adults of *C. morio* from those of other Brazilian species.

*Synonyms and Types.*— We have not seen the type of *C. morio*. The name is based upon comparison of the original description with specimens on loan.

*Description.*—

*Body length.* 6.5-10.0 mm M and F.

*Body colour.* Dorsum dull, black, metallic reflections faint, matte patterns on elytra. Pleuron and venter semi-glossy to glossy, black, metallic reflections more obvious.

*Body setae.* Pleuron setose (appressed mainly). Lateral portions of abdominal sterna one to six in males and one to five in females with sparse to moderately dense appressed setae.

*Other external features.* Antennal articles 5-6 paler than 1-4 and 7-11. Labrum elongate, convex seven to 12-dentate (basically nine); deep marginal notches each with one marginal seta (eight to 10 setae total) (Figs. 117a-e). Pronotum widest in anterior 0.5, sutures shallow (Figs. 124a-e). Coupling sulcus of mesepisternum of female a broad groove. Apex of front and middle trochanters with a single sensory seta. Elytra with small apical spine. Pattern of elytral maculation varies from completely immaculate to extensive, but with pale maculations lacking on the front part of the shoulder (Figs. 131a-e). Punctures of elytra shallow, green.

*Female genitalia.* Sternum 8 with deep V-shaped apical emargination, each apex with two or three thick setae. Median margin of second gonocoxa with row of setae (Figs. 138a, 139a, 140a). Syntergum 9 and 10 as in Figures 138b, 139b, 140b. Ventral sclerite in one piece, or two parts, a central one with recurved apex (anvil-shaped in lateral aspect), and left lateral flattened piece; setose (Figs. 138c, 139c, 140c). Oviduct sclerite shield-shaped (Figs. 138c, 139c, 140c). Bursa with small ventral sac on right side (Figs. 138c, 139c, 140c). Spermatheca and duct ca 1.75 mm long.

*Male genitalia.* Median lobe stout with short tapered apex (Figs. 148a-c, 149). Internal sac with flagellum 1.5 loops at base (Figs. 148d, e). Tooth elongate field. Arciform piece large. Stylet large (Figs.

148d, e). Right bar and small stiffening rib well developed (Figs. 148d, e). Two or three apical brush-like patches (Figs. 148d, e).

*Geographical Variation.*— A considerable amount of variation occurs in body size, dentition and number of submarginal setae of the labrum, and pattern of the elytral maculations, but geographical patterns are unclear. Variation in these characteristics was considerable in the Santarem population sample. Adults of the *C. acompsa* form which have extensive pale maculations on the elytra are not given subspecific status as they are found with conspecific adults which have various elytral patterns.

*Relationships.*— *Cicindela morio* and *C. marquardtii* are sister species.

*Habitat and Period of Activity.*— Adults are active beside fresh water from October to January. One specimen was collected in June.

*Geographical Distribution, Localities, Examined Specimens.*— Inland, from Amazon River south to Matto Grosso, Brazil (Fig. 156).

Brazil. *Amazonas*. Manaus, 1M, INPA, 1M, 1F, IOC; Manaus (1 km w. Taruma Falls), 1F, ICCM; Manaus (Biseço L.), 1M, MZSP; no locality, 3M, 1F, INPA. *Goiás*: Chapada, 5M, 5F, ICCM; Dianópolis, 8M, 10F, MZSP; Jatai, 1M, 1F, BMNH, 2M, 2F, MZSP. *Matto Grosso*: Barra do Tapirapes, 1F, CASC, 1M, MZSP; Corumba, 1M, MZSP; Utiariti, 1M, MZSP. *Pará*: Belem, 1M, CASC; no locality, 1F, BMNH; Santarem, 4M, 4F, ICCM. *São Paulo*: Avanhand (Garbe L.)\*, 1F, MZSP.

### *Cicindela (Cylindera) marquardtii* Horn

Figs. 118, 125, 132, 141, 142, 150, 151, 156

*Cicindela marquardtii* Horn, 1906: 91 (SYNTYPES, 4 males and 2 females in the IPZE bearing the following labels: "Staudinger Matto Grosso oder São Paulo/Type ! coll. W. Horn/ syntypus" (black letters on red label); TYPE LOCALITY, São Paulo int. aut Matto Grosso); 1915: 28,29,404; 1924: 48; 1926b: 77; 1938: 52.—Blackwelder, 1944: 18.—Rivalier, 1954: 265.

*Recognition.*— Diagnostic characteristics which distinguish adults of *C. marquardtii* from those of other Brazilian species are the combination of the greenish head and pronotum contrasting with dark brown to black dull elytra, complete and broad apical and humeral lunules (Figs. 132a, b), sparse appressed setae on lateral portions of abdominal sterna 3,4,5 and several lateral setae on 2 and 6, and female and male genitalia as shown in Figures 141, 142,150,151.

#### *Description.*—

*Body length.* 7.5-8.0 mm M, ca 8.5 mm F.

*Body colour.* Head and pronotum are rugose with dark brown ground colour and bright green (mainly) and coppery reflections. Elytra dull, velvety, dark brown with hint of purple. Pleuron and venter glossy, testaceous to dark brown with faint metallic reflections. Proepisternum coppery or coppery-green.

*Body setae.* Proepisternum moderately setose. Dense appressed setae on ventral 0.33 of mesepisternum, mesepimeron, metepimeron and lateral 0.33 of mesosternum. Sparse appressed setae on lateral portions of abdominal sterna 3, 4, 5, and 2 and 6 with several setae only.

*Other external features.* Tooth of mentum short and sharply pointed. Labrum convex, elongate, five dentate (three prominent anterior, two small lateral), and six marginal setae (four anterior, two lateral) (Figs. 118a, b). Pronotum short, convex widened at anterior end, sutures deep (Figs. 125a, b). Coupling sulcus of mesepisternum of female a groove with deepened middle portion. Apex of front and middle trochanters with one sensory seta. Elytra with apices recurved in females, apical spine small. Humeral and apical lunules broad and complete, middle and marginal bands absent. Punctuation shallow, obscure, green, broader punctures near shoulder and median suture (Figs. 132a, b). A few fine setae near shoulder and median



suture.

*Female genitalia.* Sternum 8 with narrow, deep V-shaped emargination in the apical end, apices each with two or three stout setae (Figs. 141a, 142a). Second gonocoxa with setae along medial margin (Figs. 141a, 142a). Second gonapophyses elongate with medial portion slightly shorter than the lateral portion (Figs. 141a, 142a). Syntergum 9 and 10 as in Figures 141b, 142b. Ventral sclerite in two parts with setae on lateral margins and anterior ends (Figs. 141c, 142c,d). Oviduct sclerite shield-shaped, or square (Figs. 141c, 142c). Bursa copulatrix with ventral sac on right (Figs. 141c, 142c,d). Spermatheca and duct approximately 2.0-3.0 mm.

*Male genitalia.* Median lobe stout with short tapered apex (Figs. 150a,c, 151a-c). Internal sac with flagellum 1.5 loops at base. Tooth dark elongate field. Arciform piece large. Central plate lightly sclerotized. Stylet large. Right bar and small stiffening rib well developed. Two or three apical finger-like brushes and small dark sclerite in right-ventral side of sac (Figs. 151a, d, e).

*Geographical Variation.*— Geographical patterns of variation have not been determined because few specimens of *C. marquardtii* have been studied. The pattern of elytral maculations and sclerites of the female genitalia show limited intrapopulation variation.

*Relationships.*— *Cicindela marquardtii* and *C. morio* are sister species.

*Habitat and Period of Activity.*— Adults have been collected beside rivers in January.

*Geographical Distribution, Localities, Examined Specimens.*— The total range of *C. marquardtii* is restricted to a small area in Matto Grosso, Brazil (Fig. 156).

Brazil. *Matto Grosso*: no locality, 4M, 2F, IPZE; Trás Lagoas, 1M, 6F, MZSP; Vacaria, 6M, 4F, MZSP.

#### The *friedenreichi* group

Adults of this group are characterized by reduced and partially depressed pale elytral maculations, and elongate apex of the median lobe. The group has three species, all of which are found in Brazil, *C. piligera*, *C. obsoletesignata* and *C. friedenreichi*. The geographical range of the *friedenreichi* group is centered in southeastern Brazil and extends westward to Ecuador. The *friedenreichi* and *morio* groups are sisters.

#### *Cicindela (Cylindera) piligera* Horn

Figs. 119, 126, 133, 143, 144, 152, 157

*Cicindela piligera* Horn, 1897b: 18 (TYPE LOCALITY, Minas Geraes); 1915: 406; 1926a: 307; 1938: 52.— Blackwelder, 1944: 19.— Rivalier, 1954: 265.

*Recognition.*— The character state combination of elongate labrum with seven uneven marginal teeth, elytra with maculations reduced to three depressed spots and large depression in basal 0.33, and a membranous sac on the ventral right side of the bursa copulatrix, together are diagnostic of *C. piligera*.

*Synonyms and Types.*— An examination of the holotype (IPZE) served to establish the name of this rare species.

*Description.*—

*Body length.* 7.5 mm M, 7.0-7.5 mm F.

*Body colour.* Dorsum slightly glossy, pleuron and venter glossy. Ground colour black; dorsum with slight coppery (mainly) and green reflections; pleuron and venter with coppery, green, and blue reflections.

*Body setae.* Lateral margins of the elytra, pleuron including ventral 0.5 of proepisternum and ventral end of mesepisternum, and lateral portions of metasternum, metacoxa, and abdominal sterna 1-6 (males) and 1-5 (females), setose.

*Other external features.* Labrum elongate seven dentate (not well defined in some specimens) with six marginal setae (Figs. 119a, b). Pronotum widest in middle sutures moderately deep (Figs. 126a, b). Coupling sulcus of mesepisternum of female a groove with central pit. Apex of front and middle trochanters with one seta. Elytra with recurved apices, apical spine small. Maculations reduced to three depressed spots. Punctures large green, row or large punctate depressions along median suture, large depression in basal 0.33 (Figs. 133a, b). Microsculpture isodiametric, bead-like.

*Female genitalia.* Sternum 8 with moderately deep and narrow apical emargination, apices narrow, each with three long stout setae (Figs. 143a, 144a). Second gonocoxa with a few setae along medial margin (Figs. 143a, 144a). Second gonapophyses and syntergum 9 and 10 as in Figures 143a, b, 144a, b. Bursa with sac on ventral right side (Figs. 143c, 144c). Ventral sclerite with posterior emargination and lateral projections, setose apical extension on right dorsal side (Figs. 143c, d, 144c). Oviduct sclerite shield-like (Figs. 143c, 144c). Spermatheca duct fused to bursa at base, spermatheca duct at least 1.25 mm (broken in dissection).

*Male genitalia.* *Cicindela piligera* type; median lobe as in Figures 152a-c. Flagellum 1.5 loops at base (Fig. 152e). Stylet, arciform piece, right bar, small stiffening rib and central plate all well developed (Figs. 152d, e).

*Geographical Variation.*— Insufficient material for analysis.

*Relationships.*— *Cicindela piligera* and *C. obsoletesignata* are sister species.

*Habitat and Period of Activity.*— Unknown.

*Geographical Distribution, Localities, Examined Specimens.*— Two adults have been collected in Minas Gerais, Brazil and one in Ecuador (Fig. 157).

Brazil. no locality, 1F, IPZE. *Minas Gerais*: no locality, 1M (holotype), 1F, IPZE.

Ecuador. No locality, 1F, BMNH.

#### *Cicindela (Cylindera) obsoletesignata* Horn

Figs. 120, 127, 134, 145, 153, 157

*Cicindela obsoletesignata* Horn, 1895b: 91 (TYPE LOCALITY, St. Catharina); 1896c: 169; 1915: 406; 1926a: 307; 1938: 52. —Blackwelder, 1944: 19. —Rivalier, 1954: 263. —Vidal Sarmiento, 1966b: 31. —Sumlin 1979: 105.

*Recognition.*— The character state combination of the black body; unidentate labrum, dark at the base, with six almost marginal setae (seven in a few specimens) (Fig. 120); sparse and fine body setae; and depressed obsolete maculations of the elytra (Fig. 134) distinguishes adults of *C. obsoletesignata* from those of other Brazilian species of *Cicindela*.

*Synonyms and Types.*— The name *C. obsoletesignata* is based upon an examination of the holotype and three females and one male determined by Horn.

*Description.*—

*Body length.* 6.0 mm M, 7.0-7.5 mm F.

*Body colour.* Body with dull to slightly glossy dorsum and slightly glossy venter; black, with black to rufopiceous venter of abdomen, genae with metallic reflections in some specimens, a hint of metallic reflection from dorsum and venter.

*Body setae.* Fine sparse setae on pleuron and sterna 1-5 (female) and 1-6 (male) of abdomen.

*Other external features.* Labrum unidentate, with 6 almost marginal setae (Fig. 120). Pronotum slightly wider anteriorly, sutures shallow (Fig. 127). Coupling sulcus of mesepisternum of female a distinct dorso-ventral groove. Apex of front trochanters each with one seta, middle trochanters glabrous. Elytra with

apices slightly recurved or not, apical spine tiny or obsolete; maculations depressed with effaced or obsolete middle band and apical lunule; punctures shallow, green; row of large markedly depressed punctures near median suture and shoulder (Fig. 134).

*Female genitalia.* Sternum 8 with wide and moderately deep apical emargination; apices each with three short stout setae (Fig. 145a). Second gonocoxa with grooves in medial margin (Fig. 145a). Second gonapophyses as in Figure 145a. Syntergum 9 and 10 rectangular (Fig. 145b), bursa with larged wrinkled and folded membranous sac with darkened area (Figs. 145c-f). Ventral sclerite wide, with a posterior emargination and lateral projections; right dorsal apical extension of ventral sclerite setose (Figs. 145c-f). Oviduct sclerite shield-like (Fig. 145c), spermatheca and duct lost in dissection.

*Male genitalia.* Median lobe and internal sac *C. obsoletesignata* type (Figs. 153a-e); flagellum 1.5 loops at base (Figs. 153d, e). Stylet prominent (Figs. 153d, e). Arciform piece, right bar, small stiffening rib, and central plate present (Figs. 153d, e).

*Geographical Variation.*— An adequate number of specimens was not available for the determination of patterns of geographic variation.

*Relationships.*— *Cicindela obsoletesignata* and *C. piligera* are sister species.

*Habitat and Period of Activity.*— Unknown.

*Geographical Distribution, Localities, Examined Specimens.*— Figure 157.

Argentina. *Chaco*: no locality, 1F, IPZE.

Brazil. *Santa Catarina*: no locality, 1M, 3F (including type), IPZE.

### *Cicindela (Cylindera) friedenreichi* Dokhtoureff

Figs. 121, 128, 135, 146, 154, 157

*Cicindela friedenreichi* Dokhtoureff, 1887: 154 (TYPE LOCALITY, Sta. Catharina).— Horn, 1904: 87; 1915: 407; 1926a: 309; 1938: 52. —Blackwelder, 1944: 18.—Rivalier, 1954: 263.—Mandl, 1963: 578.

*Recognition.*— The character state combination of the unidentate labrum with seven or eight setae close to the anterior margin (Figs. 121a, b), dark body, and elytra with a humeral spot, complete and broad apical lunule, elongate and depressed middle band (Figs. 135a, b), and a row of very large depressed punctures along the median suture distinguishes adults of *C. friedenreichi*.

*Synonyms and Types.*— The name is based upon comparison of the original description with specimens on loan from R.R. Murray.

*Description.*—

*Body length.* 7.5 mm M, 7.5-8.0 mm F.

*Body colour.* Dark, almost black with coppery and green reflections, dorsum slightly glossy, venter glossy.

*Body setae.* Appressed setae sparse to moderate in anterior 0.5 and lateral portions of pronotum, pleuron (mesepisternum glabrous mainly), lateral portions of metasternum and metacoxa, and lateral portions of abdominal sterna 1-6 (sternum 6 of female with a few setae).

*Other external features.* Labrum convex, unidentate with seven or eight setae very close to margin (Figs. 121a, b). Pronotum widest in anterior 0.5, sutures deep in front and hind angles (Figs. 128a, b). Coupling sulcus of mesepisternum of female a long sinuate groove. Front trochanters with one sensory seta. Elytra with apical end tapered, slightly recurved in females, to small apical spine, maculations variable as in Figures 135a, b, with humeral spot and complete apical lunule, apical 0.5 of middle band elongate and depressed, distinct row of large depressed blue-green punctures near median suture and shoulder, punctuation shallow and green, microsculpture isodiametric bead-like.

*Female genitalia.* Sternum 8 with deep V-shaped apical emargination, apices each with three stout setae (Fig. 146a). Second gonocoxa with grooves on median margin, second gonapophyses as in Figure 146a. Syntergum 9 and 10 as in Figure 146b. Ventral sclerite with a pair of setose anterior lobes, anvil-shaped (Figs. 146a-e). Spermatheca and duct lost in dissection.

Table 1. Classification of characters used in the construction of a genealogy of the Brazilian species of *Cicindela*

No.	Character	Character State	
		Plesiomorphous	Apomorphous
1	Body size	Average (7.0-8.0 mm)	Large (>8.0 mm) A Small (<7.0 mm) A <sup>1</sup>
2	Head and pronotum: colour	Dark brown to black with some metallic reflections	Bright coppery (with green in some specimens) B Metallic green or blue B <sup>1</sup>
3	Head and pronotum: rugosity	Shallow	Deep C
4	Rugosity between eyes	Shallow, no swirls	Two shallow pits (swirls of rugosity) D Deep D <sup>1</sup>
5	Proepisternum punctuation	Shallow, random	Deep, few, evenly distributed E
6	Elytra surface	Dull	Matte, velvety F Slightly glossy F <sup>1</sup> Glossy F <sup>2</sup>
7	Elytra: ground colour	Dark brown to black with faint metallic reflections	Metallic reflections (coppery and green), brighter G Faintly purple G <sup>1</sup>
8	Frons: setae	Absent	Present H Dense appressed H <sup>1</sup>
9	Clypeus: setae	Absent	Present I Dense appressed I <sup>1</sup>
10	Genae: setae	Absent	Present J Dense appressed J <sup>1</sup>
11	Proepisternum: setae	Sparse	Moderate K Dense K <sup>1</sup> Dense appressed K <sup>2</sup> Absent K <sup>3</sup>
12	Mesepisternum: setae	Sparse	Moderate L Dense L <sup>1</sup> Dense appressed L <sup>2</sup> Glabrous L <sup>3</sup>

(continued on next page)

Table 1 (continued)

No.	Character	Character State	
		Plesiomorphous	Apomorphous
13	Middle of abdominal sterna: setae	Absent	Present M Few additional erect M <sup>1</sup>
14	Setose lateral portions of abdominal sterna	1-6	1-5 N 2-6 N <sup>1</sup> 3-6 sparse N <sup>2</sup> 1-3 N <sup>3</sup>
15	Labrum: width	Average	Narrow O Elongate centre O <sup>1</sup> Elongate O <sup>2</sup>
16	Labrum: margin	Unidentate	Edentate P Tridentate P <sup>1</sup> 5-Dentate P <sup>2</sup> 7-Dentate P <sup>3</sup> >7-Dentate P <sup>4</sup>
17	Labrum: setae position	Submarginal	Nearer to margin (some or all setae) Q Marginal Q <sup>1</sup>
18	Labrum: setae	8 (average)	<8 (average) R >8 (average) R <sup>1</sup>
19	Mentum tooth: length	Average	Short S Long S <sup>1</sup>
20	Antenna segments: colour	Normal	5-6 pale T 5-11 pale T <sup>1</sup>
21	Pronotum: width	Average	Narrow U Broad U <sup>1</sup>
22	Coupling sulcus: shape	Groove (direct)	Groove with deeper centre V Groove with central pit V <sup>1</sup> Pit V <sup>2</sup> Almost absent V <sup>3</sup>
23	Middle trochanter: setae	Absent	Present W
24	Abdominal sternum 5 of ♀: unpigmented bell-shaped spot	Absent	Present X

(continued on next page)

Table 1 (continued)

No.	Character	Character State	
		Plesiomorphous	Apomorphous
25	Elytra: pale markings	Narrow to broad, complete or almost complete	Reduced Y Reduced and partially depressed Y <sup>1</sup> Effaced Y <sup>2</sup> Broad and fused Y <sup>3</sup> Broad, fused, ragged, spotted Y <sup>4</sup> Ragged Y <sup>5</sup> Narrow, fused, partly ragged and spotted Y <sup>6</sup>
26	Elytra: foveae	Obvious near shoulder and median suture	Not obvious Z Few Z <sup>1</sup> Absent Z <sup>2</sup> Very large Z <sup>3</sup>
27	Abdominal sternum 8 ♀: apical emargination	Broad, average depth	Broad, deep a Broad, shallow a <sup>1</sup> Very broad, deep a <sup>2</sup> Very broad, shallow a <sup>3</sup> Narrow, deep a <sup>4</sup>
28	Abdominal sternum 8 ♀: stout apical setae size	Average length	Short b Long b <sup>1</sup>
29	Abdominal sternum 8 ♀: stout apical setae number	2-3	4 c 5 c <sup>1</sup> >5 c <sup>2</sup>
30	Ventral sclerite: shape	Broad, tapered posteriorly	With median ridge d Two elongate posterior projections d <sup>1</sup> Two anterior lobes and two posterior projections d <sup>2</sup>
31	Ventral sclerite: setae	Absent	Present e
32	Oviduct sclerite: form	Shield-shaped	Rectangular, not laterally broadened f Narrow f <sup>1</sup> Membranous f <sup>2</sup>

(continued on next page)

Table 1 (continued)

No.	Character	Character State	
		Plesiomorphous	Apomorphous
33	Spermatheca and duct: length	1.0–1.5 mm	1.5–2.5 mm g >2.5 mm g <sup>1</sup>
34	Bursa copulatrix: setae	Absent	Present h
35	Bursa copulatrix: shape	Normal	One ventral right out- pocketing i Two anterior lateral out- pocketings i <sup>1</sup>
36	Median lobe: apex	Short	Short, ventral notch j Hooked ventrally j <sup>1</sup> Elongate j <sup>2</sup> Bent dorsally j <sup>3</sup>
37	Flagellum	Present	Absent k Fewer than 1 1/2 coils (loops) at base k <sup>1</sup>
38	Tooth: condition	Sclerotized	Membranous l
39	Tooth: shape	Elongate	Elongate with spatulate apex m Short m <sup>1</sup> Elongate arising from two long thin roots of equal length m <sup>2</sup>
40	Internal sac: two finger- like darkened fields, one spatulate-like	Absent	Present n
41	Arciform piece: shape	Narrow	Broad o Very broad tapered apically o <sup>1</sup>
42	Arciform piece: position	Oblique	Longitudinal p
43	Central plate	Not joined to shield	Joined to shield q Absent q <sup>1</sup>
44	Shield	Present	Absent r

(continued on next page)

Table 1 (continued)

No.	Character	Character State	
		Plesiomorphous	Apomorphous
45	Shield: shape	Single apex	Single apex tapered s Single apex rounded s <sup>1</sup> Single apex rounded, bent s <sup>2</sup> Single apex tridentate s <sup>3</sup> Two apices s <sup>4</sup> Two apices short, blunt, s <sup>5</sup> Heart-shaped two apical lobes s <sup>6</sup> Two apices elongate s <sup>7</sup> Two apices long filamentous s <sup>8</sup> Two apices, one a prominent round lobe s <sup>9</sup> Two apices, round lobe, short spine s <sup>10</sup> Three apical lobes s <sup>11</sup> Folded laminate s <sup>12</sup> Folded laminate leaf-like s <sup>13</sup> Reduced s <sup>14</sup>
46	Small stiffening rib	Present	Absent t
47	Stylet	Present	Absent u
48	Stylet: form	Average length to long	Short v Bifid v <sup>1</sup> Broad v <sup>2</sup>
49	Sagittal sclerotized plates	Absent	One present w Two present w <sup>1</sup>
50	Cuña (triangular piece)	Absent	Short x Long x <sup>1</sup>





Table 2 (continued)

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
<i>halophila</i>	.A	B	.	.	F <sup>2</sup>	G	H	.	J	K <sup>2</sup>	.	.	N	.	.	R	.	.	V <sup>2</sup>	W	.	Y <sup>3</sup>	.	a <sup>3</sup>	b <sup>1</sup>	c <sup>2</sup>	.	.	.	h	.	.	.	m <sup>2</sup>	.	.	q <sup>1</sup>	.	.	.	.	.	.	.	.	.	.	x <sup>1</sup>		
<i>sioclaioola</i>	A	B	.	.	F <sup>2</sup>	G	H	I	J	K <sup>1</sup>	.	M <sup>1</sup>	N	.	.	R	S <sup>1</sup>	.	U <sup>1</sup>	V <sup>3</sup>	.	Y <sup>3</sup>	Z	.	b <sup>1</sup>	c <sup>2</sup>	d <sup>1</sup>	.	g <sup>1</sup>	h	.	.	.	m	.	.	o	.	.	s <sup>12</sup>	.	.	v	.	xx <sup>1</sup>					
<i>sinuosa</i>	A	B	.	.	F <sup>2</sup>	G	.	.	.	K <sup>2</sup>	.	M <sup>1</sup>	.	.	.	R <sup>1</sup>	S <sup>1</sup>	.	U <sup>1</sup>	.	.	Y <sup>3</sup>	Z <sup>2</sup>	.	b <sup>1</sup>	c <sup>2</sup>	d <sup>1</sup>	.	g <sup>1</sup>	.	.	.	.	.	m	.	.	.	q <sup>1</sup>	.	.	s <sup>12</sup>	.	.	.	.	x			
<i>euturalis</i> ♂	.AA <sup>1</sup>	B	.	.	F <sup>1</sup>	G	.	.	.	K <sup>2</sup>	L <sup>2</sup>	.	.	0	.	.	.	.	.	.	.	Y <sup>3</sup>	Z <sup>2</sup>	a	.	.	d <sup>1</sup>	.	g <sup>1</sup>	.	.	.	.	.	m	.	.	.	.	.	.	.	.	s <sup>12</sup>	.	.	.	.	.	
<i>hirsutifrons</i> ♂	A	B	.	.	F <sup>1,2</sup>	G	H <sup>1</sup>	I <sup>1</sup>	J <sup>1</sup>	K <sup>2</sup>	L <sup>2</sup>	M	.	0 <sup>2</sup>	.	.	R	.	U <sup>1</sup>	.	.	Y <sup>3</sup>	Z	.	a <sup>1</sup>	b <sup>1</sup>	c <sup>2</sup>	d <sup>1</sup>	.	g <sup>1</sup>	.	.	.	.	.	m	.	.	.	.	s <sup>12</sup>	.	v <sup>2</sup>	.	.	x				
<i>nivea</i> ♂	A	B	.	.	F <sup>1</sup>	G	H <sup>1</sup>	I <sup>1</sup>	J <sup>1</sup>	K <sup>2</sup>	L <sup>2</sup>	M	.	0	.	.	S <sup>1</sup>	.	U <sup>1</sup>	.	.	Y <sup>4</sup>	Z <sup>1</sup>	a <sup>3</sup>	b <sup>1</sup>	c <sup>2</sup>	d <sup>1</sup>	.	g <sup>1</sup>	.	.	.	.	.	m	.	.	.	.	s <sup>12</sup>	.	.	.	v <sup>2</sup>	.	x				
<i>ramosa</i>	A	B	.	.	F <sup>1</sup>	G	H <sup>1</sup>	I <sup>1</sup>	J <sup>1</sup>	K <sup>2</sup>	L <sup>2</sup>	M <sup>1</sup>	N	.	.	.	S <sup>1</sup>	.	U <sup>1</sup>	V <sup>3</sup>	W	.	Y <sup>4</sup>	Z <sup>1</sup>	a <sup>3</sup>	b <sup>1</sup>	c <sup>2</sup>	d <sup>1</sup>	.	g <sup>1</sup>	.	.	.	.	.	m	.	.	.	.	s <sup>12</sup>	.	u	.	.	x <sup>1</sup>				
<i>nahuelbutae</i>	A	.B	.	.	F <sup>1</sup>	G	H <sup>1</sup>	I <sup>1</sup>	J <sup>1</sup>	K <sup>2</sup>	L <sup>2</sup>	M	.	.	.	R <sup>1</sup>	S <sup>1</sup>	.	U <sup>1</sup>	.	.	Y <sup>4</sup>	.	.	.	.	.	.	.	.	.	.	.	.	.	m	.	.	.	o	.	s <sup>12</sup>	.	.	u	.	.	x <sup>1</sup>		
<i>mitula</i>	A	.B	.	.	F <sup>1</sup>	G	H	I	J	K <sup>2</sup>	.	.	N	.	.	.	R <sup>1</sup>	S <sup>1</sup>	.	U <sup>1</sup>	.	.	Y <sup>5</sup>	Z <sup>2</sup>	a <sup>1</sup>	b <sup>1</sup>	c <sup>1</sup>	d <sup>1</sup>	.	g <sup>1</sup>	.	.	.	.	.	m	.	.	.	o	.	s <sup>13</sup>	.	.	u	.	.	x <sup>1</sup>		
<i>riteimai</i>	.A	.	.	.	.	.	H	I	J	K	.	.	.	.	.	.	R	S <sup>1</sup>	.	U <sup>1</sup>	V	.	Y <sup>4,6</sup>	Z <sup>3</sup>	.	b	cc <sup>1</sup>	d <sup>1</sup>	.	g <sup>1</sup>	.	.	.	.	.	m	.	.	.	o	.	q <sup>1</sup>	.	s <sup>12</sup>	.	v <sup>2</sup>	.	.	x	
<i>drakei</i>	.A	.	.	.	.	.	H	I	J	K	L	.	N	.	0	.	.	R <sup>1</sup>	S <sup>1</sup>	.	U <sup>1</sup>	.	Y <sup>4,6</sup>	Z <sup>3</sup>	.	b	cc <sup>1</sup>	d <sup>1</sup>	.	g <sup>1</sup>	.	.	.	.	.	m	.	.	.	o	.	q <sup>1</sup>	.	s <sup>12</sup>	.	v	.	.	x <sup>1</sup>	
<i>malaleuca</i> ♂	A	.	.	.	.	.	H	I	J	K	L	.	N	.	0 <sup>2</sup>	.	.	R <sup>1</sup>	S <sup>1</sup>	.	U <sup>1</sup>	.	Y <sup>4</sup>	Z <sup>3</sup>	.	.	c <sup>2</sup>	d <sup>1</sup>	.	g <sup>1</sup>	.	.	.	.	.	m	.	.	.	o	.	s <sup>12</sup>	.	u	.	.	x <sup>1</sup>			
<i>patagonica</i> ♂	A	.	.	.	F <sup>2</sup>	.	H	I	.	K	L	.	N	.	.	.	.	.	U <sup>1</sup>	.	.	Y <sup>4</sup>	Z <sup>3</sup>	.	.	c <sup>2</sup>	d <sup>1</sup>	.	g <sup>1</sup>	.	.	.	.	.	.	m	.	.	.	.	s <sup>12</sup>	.	u	v	.	.	x <sup>1</sup>			
<i>gormazi</i>	A	.	.	.	.	.	H	I	J	K	.	M <sup>1</sup>	N	0	.	.	R <sup>1</sup>	S <sup>1</sup>	.	U <sup>1</sup>	.	W	.	Y <sup>5</sup>	Z <sup>3</sup>	.	b	c	d <sup>1</sup>	.	.	.	.	.	.	m <sup>1</sup>	.	.	.	q <sup>1</sup>	.	s <sup>12</sup>	.	u	.	.	x <sup>1</sup>			
<i>ohillensis</i>	.A	.	.	.	.	.	H	I	J	K	.	.	N	0	.	.	R <sup>1</sup>	.	U <sup>1</sup>	V	W	.	Y <sup>5</sup>	Z <sup>3</sup>	.	b	c	d <sup>1</sup>	.	g	.	.	.	.	k <sup>1</sup>	.	m	.	.	.	o	.	s <sup>12</sup>	.	v	.	.	x <sup>1</sup>		
<i>nigrovittata</i> ♂	.A	.	C	D	.	F	.	H	.	J	.	.	N	0 <sup>2</sup>	P <sup>1</sup>	.	R	S <sup>1</sup>	.	U <sup>1</sup>	V <sup>3</sup>	.	Y	Z <sup>2</sup>	a	b	c <sup>1</sup>	d <sup>1</sup>	.	g	.	i <sup>1</sup>	.	.	.	m	.	.	.	o	.	q <sup>1</sup>	.	s <sup>12</sup>	.	u	.	.	.	
<i>eugeni</i> ♂	.	.	.	.	.	.	H	.	.	.	.	.	N	0	.	.	R <sup>1</sup>	.	U <sup>1</sup>	.	.	Y <sup>4</sup>	Z <sup>1</sup>	.	b	.	c <sup>1</sup>	.	g	.	.	.	.	.	.	.	.	.	.	q <sup>1</sup>	.	s <sup>14</sup>	.	.	.	.	.	x		
<i>apiata</i> ♂	.A	.	.	.	.	.	.	.	.	.	.	.	N	0	.	.	R <sup>1</sup>	.	U <sup>1</sup>	.	.	Y <sup>4</sup>	Z <sup>1</sup>	.	b	.	c <sup>1</sup>	.	g	.	.	.	.	.	.	.	.	.	.	.	r	.	s <sup>14</sup>	.	.	.	.	x		
<i>kollari</i> ♂	.A <sup>1</sup>	B	.	.	F <sup>1</sup>	.	.	.	.	K <sup>1</sup>	.	.	N	0	.	.	R	T <sup>1</sup>	.	U <sup>1</sup>	.	W	.	Y <sup>3</sup>	Z <sup>1</sup>	a <sup>3</sup>	.	.	d <sup>1</sup>	.	g	.	.	j <sup>2</sup>	.	i	.	.	.	.	.	r	.	.	.	.	.			
<i>malaria</i> ♂	A <sup>1</sup>	.	.	.	F <sup>1</sup>	.	.	.	J	K <sup>1</sup>	.	.	.	0	P	.	.	.	U <sup>1</sup>	.	W	.	Y <sup>3</sup>	Z <sup>2</sup>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
<i>confluentesignata</i> ♂	A	.	.	.	F <sup>1</sup>	.	.	.	J	K	L	.	.	0 <sup>2</sup>	P <sup>3</sup>	0	R	.	T <sup>1</sup>	U <sup>1</sup>	.	.	Y <sup>3</sup>	Z <sup>1</sup>	a <sup>4</sup>	.	cc <sup>1</sup>	d <sup>2</sup>	e	f	.	.	i	j <sup>3</sup>	.	l	.	.	.	.	o <sup>1</sup>	r	.	.	.	.	x			
<i>granulipennis</i> ♂	A	.	.	.	.	.	.	.	.	J	.	.	.	0 <sup>2</sup>	p <sup>4</sup>	0 <sup>1</sup>	.	.	U	.	.	Y	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
<i>mario</i> ♂	.AA <sup>1</sup>	.	.	.	F	.	.	.	.	K	L	.	N	0 <sup>2</sup>	p <sup>4</sup>	0 <sup>1</sup>	.	R <sup>1</sup>	.	T	U <sup>1</sup>	.	W	.	Y <sup>2,3</sup>	Z <sup>1</sup>	a	b	.	d <sup>2</sup>	e	.	g	.	f	.	.	l	.	.	.	q <sup>1</sup>	r	.	.	v	.			
<i>marquardtii</i> ♂	.A	.	C	.	F	G <sup>1</sup>	.	.	.	K	L <sup>1</sup>	.	N <sup>1</sup>	0 <sup>2</sup>	p <sup>2</sup>	0 <sup>1</sup>	.	R	S	.	U <sup>1</sup>	V	W	.	Y	Z <sup>1</sup>	a <sup>4</sup>	b	.	d <sup>2</sup>	e	.	g <sup>1</sup>	.	f	.	l	.	.	.	q <sup>1</sup>	r	.	.	.	.	.			
<i>piligera</i> ♂	.	.	.	.	F <sup>1</sup>	.	.	.	.	K	L	.	N	0 <sup>2</sup>	p <sup>3</sup>	0 <sup>1</sup>	.	R	.	.	V	W	.	Y <sup>1</sup>	Z <sup>1</sup>	a	.	.	d <sup>2</sup>	e	.	.	f	j <sup>2</sup>	.	.	.	.	.	.	.	.	r	.	.	.	.			
<i>obsoletesignata</i> ♂	.A <sup>1</sup>	.	.	.	F <sup>1</sup>	.	.	.	.	.	.	.	N	0 <sup>2</sup>	Q	R	.	.	.	.	.	.	Y <sup>1</sup>	.	a <sup>2</sup>	b	.	d <sup>2</sup>	e	.	.	f	j <sup>2</sup>	.	.	.	.	.	.	.	.	r	.	.	.	v <sup>1</sup>	.			
<i>friedenreichi</i> ♂	.	.	.	.	F <sup>1</sup>	.	.	.	.	K	L	.	.	0 <sup>2</sup>	Q	R	.	.	.	.	.	.	Y <sup>1</sup>	Z <sup>3</sup>	a	.	.	d <sup>2</sup>	e	.	.	j <sup>2</sup>	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.			

\* Letters, apotypic characters from Table 1; ·, plesiotypic characters; capital letters denote non-genitalic characters; lower case letters denote genitalic characters; letters and points side by side denote both plesiotypic and apotypic characters occur in the same species; dashes and blanks denote absent or undetermined characters respectively.  
+ Top and bottom letters or points indicate female and male respectively shown for Brazilian species  
⊙ Species not seen by us.  
⊗ Brazilian species.  
x Small dentiform projection.

*Male genitalia.* Median lobe with elongate and tapered apex (Figs. 154a-c). Internal sac with flagellum 1.5 loops at base. Tooth and stylet well developed. Arciform piece, right bar, small stiffening rib and central plate well developed, additional stout sclerite between small stiffening rib and right bar (Figs. 154d, e).

*Geographical Variation.*— Insufficient material was available to determine patterns of geographical variation; variable characters appear to be mainly body colour ranging from greenish to black through coppery, and the maculations of the elytra.

*Relationships.*— *Cicindela friedenreichi* is sister to the lineage that gave rise to sister species *C. piligera* and *C. obsoletesignata*.

*Habitat and Period of Activity.*— Unknown.

*Geographical Distribution, Localities, Examined Specimens.*—

Southern Brazil, Rio Grande do Sul, Santa Catarina (Fig. 157).

Brazil. *Rio Grande do Sul*. Torres, 1M, 6F, RRM.C.

#### HISTORY OF SOUTH AMERICAN SPECIES OF SUBGENERA *BRASIELLA*, *GAYMARA*, *PLECTOGRAPHA* AND *CYLINDERA*

##### Introduction

Organisms are wards of their history. Each taxon embodies an evolutionary heritage based on a special kind of ancestry. In time this legacy is altered with acquired genetic and biogeographical attributes which are carried to descendants. Natural classifications reflect these processes as part of the main course of organismic history. They present branching lineages and hereditary changes in a dichotomous phylogenetic framework.

In the phylogeny section that follows reconstructed phylogenies are based on methods and philosophy of Hennig (1966). Phylogenetic relationships are inferred from determinations of apomorphic (derived) and plesiomorphic (ancestral) characters of adult beetles from which the reconstructed genealogies are expressed. Biogeographic considerations, based on the reconstructed phylogenies, attempt to deduce distributions of species and species groups.

Brazilian and related South American taxa of *Cicindela* were included, which together appeared to form monophyletic assemblages largely within South America. We examined adult specimens of 29 Brazilian and 16 non-Brazilian species. In addition the genitalia of males and females were dissected and their characteristics documented for each of 29 and 26 Brazilian species and 10 and 11 non-Brazilian species respectively. Data for 16 non-Brazilian species not examined by us were obtained from original descriptions, writings and figures in Horn (1915, 1938), Rivalier (1954, 1955), Mandl (1963, 1973), Vidal Sarmiento (1966a,b, 1967), Peña (1969), Peña and Barria (1973), and Sumlin (1979).

##### Phylogeny

The purposes of this section are to postulate phylogenetic relationships of sister groups and to classify them. Detailed accounts and viewpoints of the method of phylogenetic reconstructions can be obtained from Hennig (1966), Ross (1974),

Eldredge and Cracraft (1980), Wiley (1981), Charig (1982), Maynard Smith (1982), and Patterson (1982).

Phylogenies are deduced in two steps. First character states are determined to be apomorphic or plesiomorphous. Second, sister groups are established from synapomorphic (shared apomorphic) character states. It is not always easy to decide the direction of a character state trend in a group (*in-group* comparison) or whether a character state is apomorphic or plesiomorphous. By comparing character states of a group with those of related groups (*out-group* comparison) usually one can decide reasonably which is apomorphic and which plesiomorphous.

Plesiomorphous and apomorphic character states of Brazilian species of *Cicindela* are postulated in Tables 1, 2 and 3, and used as the basis for the construction of phylogenetic diagrams (trees, cladograms) given in Figures 158-163. In Table 1 each character is described and numbered. Apomorphic states of non-genitalic characters are assigned a capital letter and those of genitalic characters a lower case letter. Superscript numbers placed beside the letters indicate one of two or more apomorphic states of a character, and a series of numbers indicates a morphocline. In Table 2, points and letters or numbered letters indicate plesiomorphous and apomorphic character states respectively.

Decisions about plesiomorphy and apomorphy given below are based on generalized out-group comparisons of character states among North and South American species groups or subgenera of the genus *Cicindela*. As an operational rule for out-group comparisons we followed that of Watrous and Wheeler (1981) which states that for a given character with two or more states within a group, the state occurring in related groups is assumed to be the plesiomorphous state. Thus the word common as it is used here refers to the high frequency of a plesiomorphous character state among species groups or subgenera.

*Body size (1)*. Average size plesiotypic though arbitrarily viewed, is found in most species groups.

*Head and pronotum: colour (2) and rugosity (3)*. Dark brown or black with shallow rugosity is very common and deemed plesiomorphous.

*Rugosity between eyes (4)*. Two deep rugose pits are found only in four species: apomorphic.

*Proepisternum: punctuation (5)*. Deep widely spaced punctures present in *C. anulipes* only: apomorphic.

*Elytra: surface (6) and ground colour (7)*. A dull and dark brown or black combination is plesiomorphous being the most common condition among groups.

*Setae on frons (8) clypeus (9) genae (10)*. Absence of setae is the condition of the majority of species groups: plesiomorphous.

*Setae on proepisternum (11) and mesepisternum (12)*. Density of setae tends to be a gradient condition, though the distinctly sparse state appears to be widespread: plesiomorphous.

*Setae on middle of abdomen (13)*. Absent is the plesiomorphous state.

*Setae on lateral portions of abdominal sterna (14)*. Most species bear setae on sterna 1-6: plesiomorphous.

*Labrum: width (15) and margin (16)*. The average width and unidentate states are widespread among species groups: plesiomorphous.

*Labrum setae: position (17) and number (18)*. Most species have submarginal setae (plesiomorphous); an average number of eight setae is deemed plesiomorphic among species groups though fewer than 8 is common in Brazilian species.

*Mentum tooth: length (19)*. Average length is the widespread state: plesiomorphous.

*Antenna segments: colour (20)*. Lack of metallic reflections (pale) is uncommon: apomorphous.

*Pronotum: width (21)*. Average width widespread though not uniformly so within species groups: plesiomorphous.

*Coupling sulcus: shape (22)*. A distinct groove straight or slightly sinuate is found in the majority of species groups: plesiomorphous.

*Middle trochanter: seta (23)*. Absent from most species: plesiomorphous.

*Abdominal sternum 5 of female: unpigmented bell-shaped spot (24)*. Present in a few species, apomorphous.

*Elytra: pale markings (25)*. Highly varied in detail though general features somewhat more stable; narrow to broad, complete or almost complete more prevalent than other combined conditions: plesiomorphous.

*Elytra: foveae (26)*. Obvious though not large near suture and shoulder is plesiomorphous.

*Abdominal sternum 8 of female: apical emargination (27)*. A somewhat varied character but stable within some species groups. Broad, average depth: plesiomorphous.

*Abdominal sternum 8 of female: stout apical setae size (28) and number (29)*. Average length: plesiomorphous; 2-3 characteristic of most species: plesiomorphous.

*Ventral sclerite: shape (30)*. Anterior and posterior projections and a median ridge are uncommon in most species groups of South America: apotypic; and a well defined median ridge is uncommon: apomorphous.

*Ventral sclerite: setae (31)*. The absent state is widespread: plesiomorphous.

*Oviduct sclerite: form (32)*. A shield shape is the common state: plesiomorphous.

*Spermatheca and duct: length (33)*. A short (1.0-1.5 mm) spermatheca and duct is common: plesiomorphous.

*Bursa copulatrix: setae (34) and shape (35)*. The presence of setae and outpocketings are states uncommon in South American species: apomorphous.

*Median lobe: apex (36)*. A short unhooked apex is a widespread state and by out-group comparison considered to be plesiomorphous.

*Flagellum* (37). Absence of a flagellum is uncommon within *Cicindela* world-wide: apomorphic.

*Tooth: condition* (38) *and shape* (39). A sclerotized elongate tooth is common: plesiomorphic.

*Internal sac: two finger-like darkened fields, one spatulate-like* (40). These are apomorphic if present; found in a few species.

*Arciform piece: shape* (41) *and position* (42). The narrow and oblique states are common and therefore plesiomorphic.

*Central plate* (43). A central plate not joined to the shield appears to be common: plesiomorphic.

*Shield* (44) *and* (45). A distinct shield, and single apex both plesiomorphic.

*Small stiffening rib* (46). The present rib state is slightly more common than the absent one and thus deemed to be plesiomorphic.

*Styler* (47) *and form* (48). An average to long styler is common: plesiomorphic.

*Two sagittal sclerotized plates* (49). Rarely present: apomorphic.

*Cuña* (50). A small triangular sclerite near the dorsal side of the flagellum of the male, shown by Vidal Sarmiento (1966b) to occur in species of *Plectographa* and *Cylindera*: apomorphic.

Because of the large number of diverse characters used in the reconstructed phylogeny a strict hierarchical system of character weighting was difficult to establish. As a general rule we judged characters in demonstrating relationships, from good, if stable and corroborating with other stable characters inter-specifically, to poor, if unstable intra-specifically. Characters of the male and female genitalia, morphometric features, loss of a good character, distribution of body setae, colour pattern of the elytra, and body colour, were generally but not consistently applied in descending order of value. For accounts of theory and methods of character weighting we refer the reader to Funk and Wheeler (1986), Neff (1986), and Wheeler (1986), and, in particular to how they relate to carabid beetles, to Ball and Nimmo (1983).

In the formation of a genealogy the largest groups of species that consistently share apomorphic character states are treated as evolutionary units. In our scheme they are a monophyletic complex of subgenera of *Cicindela* found primarily in South America. Four subgenera are recognized, the species of which are listed in Table 2.

The reconstructed phylogeny of the subgenus *Brasiella* (Fig. 158) is based on characters of 29 species listed in Table 2. Genital characters of males and females dissected by us were observed and documented for 11 species, and those of males only were determined from publications for 23 species. Genital characters were not determined for both sexes of four species, and for females of 14 species. Eight non-genital characters were not determined among 21 species.

Seven characters account for 12 evolutionary reversals and 44 characters for 122 parallelisms. Although 452 characters were not determined, one third of the full

potential character number 1450, we are confident that our reconstructed phylogeny of this subgenus will stand up to rigorous testing, as the system is based mainly on complex characters that frequently corroborate each other in various lineages.

The presence of setae (pubescence) on the middle of the abdominal sterna, short apical setae on abdominal sternum 8 and membranous oviduct sclerite of the female, and hooked apex of the aedeagus, absent flagellum and central plate of the male, characterize the original ancestral lineage of *Brasiella*.

The relative positions of species in the *viridicollis* group may require changing later on, because undocumented good characters are absent from this species group genealogy. However for now we treat *C. acuniai* and *C. viridicollis* as sister species on the basis of the bicolorous adult body, bright blue or green head and pronotum with brown to coppery elytra though we recognize that different relationships may be derived among species by differential weighting of B<sup>1</sup>, F<sup>1</sup>, R, Z<sup>1</sup> or Z<sup>3</sup>, and when the genitalia of both sexes for the four species become known.

The *aureola* species group consists of *C. rivalieri*, *C. amaenula* and the sister species *C. aureola*/*C. horioni*. We have not seen adults of *C. horioni* and have placed this species mainly on the basis of the maculations of the elytra as drawn by Mandl (1956: 388). A bell-shaped unpigmented area of the hind margin of sternum 5 of females is present in the latter three species, and also in species of the *argentata* species group. This is an unusual character found in no other *Brasiella* species. Therefore, we are not comfortable with this separation of the *aureola* and *argentata* groups but it seems the most parsimonious at the moment.

In the *misella* group, the positions of *C. dolosulaffinis* and *C. tippmanni* are uncertain. We have put them together as sister species on the basis of general habitus. We have not seen specimens and many adult and genitalic characters have not been documented (Table 2).

The reconstructed phylogeny of subgenus *Gaymara* is based on five species (Table 2, Fig. 159). Two characters account for two evolutionary reversals, nine characters account for nine parallelisms.

The ancestral lineage of subgenus *Gaymara* is distinguished by the characters elongate and tridentate labrum with fewer than eight setae, short apical setae on abdominal sternum eight of the female, ventral sclerite of the bursa copulatrix with two elongate posterior projections, both flagellum and small stiffening rib absent from the internal sac of male, membranous tooth of the internal sac, and central plate joined to shield.

The reconstructed phylogeny of the subgenus *Plectographa* (Fig. 160) is based on apomorphic characters of 18 extant South American species listed in Table 2. Two characters account for 34 evolutionary reversals and 16 characters for 91 parallelisms. Broad, fused, ragged and spotted maculations of the elytra, widespread among extant species, appear to have evolved independently at least four times. A large body size, long spermathecal duct, elongate tooth with a spatulate apex and folded laminate shield in the internal sac of the male distinguish the ancestral

lineage of this subgenus. The *eugenilapiata* lineage stands apart from the others of this subgenus mainly in its primitiveness. The most difficult lineage to place is the monobasic species group *halophila*. Adults of *C. halophila* superficially resemble those of the *suturalis* species group, but male genitalia are radically different. The median lobe is equipped with a short, uncoiled flagellum somewhat similar to that found in North American males of subgenus *Cicindela* and the tooth is short and rounded unlike the type found in *Plectographa* males. A long cuña is present and the shield appears stylet-like. On the other hand female genitalia are similar to those of the *suturalis* species group, particularly in the elongate shape of the ventral sclerite of the bursa copulatrix and presence of approximately eight setae on both apices of sternum 8. Thus the female genitalia were given special weight in selecting an uncertain phylogenetic position for *C. halophila*.

The species *C. siccalacicola*, *C. sinuosa* and *C. suturalis* are probably more closely related than indicated in Figure 160 but we were unable to work out a simpler scheme. On the basis of dense appressed setae on the prosternum and absence of large foveae on the elytra, *C. sinuosa* and *C. suturalis* are established sister species, and, as a consequence, glossy elytra and few erect setae in the middle of abdominal sterna become parallel characters of *C. sinuosa* and *C. siccalacicola*. If weighting of the two former and two latter characters were reversed *C. siccalacicola* and *C. suturalis* would necessarily be treated as sister species.

The species *C. nigrovittata* is tentatively presented as a monobasic species group with ancient links to *Plectographa* lineages. An unusual combination of plesiomorphous and apomorphous characters makes it uniquely different from other species of *Plectographa*. The male genitalia are distinctly *Plectographa*-like in detail. A deep rugosity forming two large swirls or pits on the head between the eyes of the adults indicates an extraordinary convergence with adults of several species in subgenus *Gaymara*.

The reconstructed phylogeny of South American lineages of subgenus *Cylindera* is based on nine species (Fig. 161, Table 2). North American species were not included as a considerable geographical gap exists between them and South American species. We assumed that species in South America are more closely related to each other than to any in North America. The relationships of *C. granulipennis* and *C. malaris* are tentative as their male and female genitalia are not known. An additional 21 and six characters were not determined for these two species and four others respectively. Seven characters account for eight evolutionary reversals and 12 characters for 28 parallelisms.

The ancestral lineage is characterized by elytra slightly glossy with a few foveae, moderately setose proepisternum, average to elongate labrum width, some or all setae of labrum very near front margin, fewer than eight labrum setae, ventral sclerite partly covered with setae and with two anterior lobes and two posterior projections, and shield absent from the bursa copulatrix.



Table 3. Apomorphous characters shared by Brazilian subgenera of *Cicindela*\*.

Code letter	Subgenera	3	4	6	7	8	9	14	16	17	19	21	22	27	30	31	32	33	35	36	37	38	41	43	44	45	46	48
A	Brasiella			F <sup>1</sup>	G	H	I			P <sup>1</sup>	Q		V <sup>1</sup>	a						j <sup>2</sup>	k		o	q <sup>1</sup>		s	t	
										p <sup>2</sup>			a <sup>1</sup>															
B	Gaymara	C	D	F	G	H	I	N	P <sup>1</sup>	Q	S <sup>1</sup>	U <sup>1</sup>	V	a <sup>1</sup>	d <sup>1</sup>	e	f	g		j <sup>2</sup>	k	l	o			s	t	v
								.																				v <sup>1</sup>
C	Plectographa	C	D	F	G	H	I	N	P <sup>1</sup>		S <sup>1</sup>	U <sup>1</sup>		a	d <sup>1</sup>			g	i				o		r		v	
				F <sup>1</sup>				.						a <sup>1</sup>				g <sup>1</sup>										v <sup>1</sup>
														a <sup>2</sup>														
														a <sup>3</sup>														
D	Cylindera	C		F				N	P <sup>2</sup>	Q		U <sup>1</sup>	V	a	d <sup>1</sup>	e	f	g	i	j <sup>2</sup>		l		q <sup>1</sup>	r		v	
				F <sup>1</sup>				.				V <sup>1</sup>	a <sup>2</sup>					g <sup>1</sup>									v <sup>1</sup>	
														a <sup>3</sup>														

\* Characters shared by two subgenera:

- AB Brasiella/Gaymara - 37,45,46
- AC Brasiella/Plectographa - none
- AD Brasiella/Cylindera - 43 (16,22)
- BC Gaymara/Plectographa - 4,19
- BD Gaymara/Cylindera - 31,32,38 (22)
- CD Plectographa/Cylindera - 35,44 (33,27)

Characters shared by three subgenera:

- ABC Brasiella/Gaymara/Plectographa - 7,8,9,41 (16,27)
- ABD Brasiella/Gaymara/Cylindera - 17,36
- ACD Brasiella/Plectographa/Cylindera - none (6,27)
- BCD Gaymara/Plectographa/Cylindera - 3,14,21,30,48 (6,33)

NOTE: Brackets indicate gradient characters

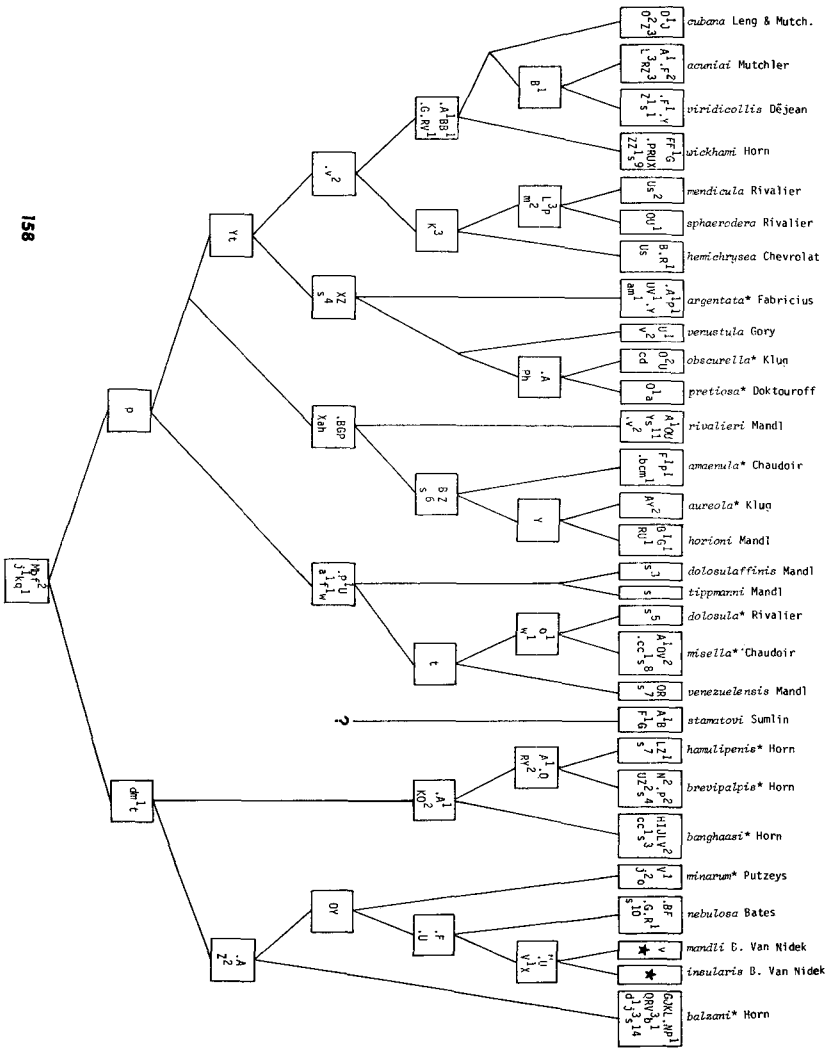


Fig. 158. Phylogenetic diagram for South American species of *Braselia*. An asterisk indicates Brazilian species. *Cicindela mandli* Brouerius van Nidek has a median lobe with a rounded hook and *C. insularis* Brouerius van Nidek, a median lobe with an abrupt hook (★).

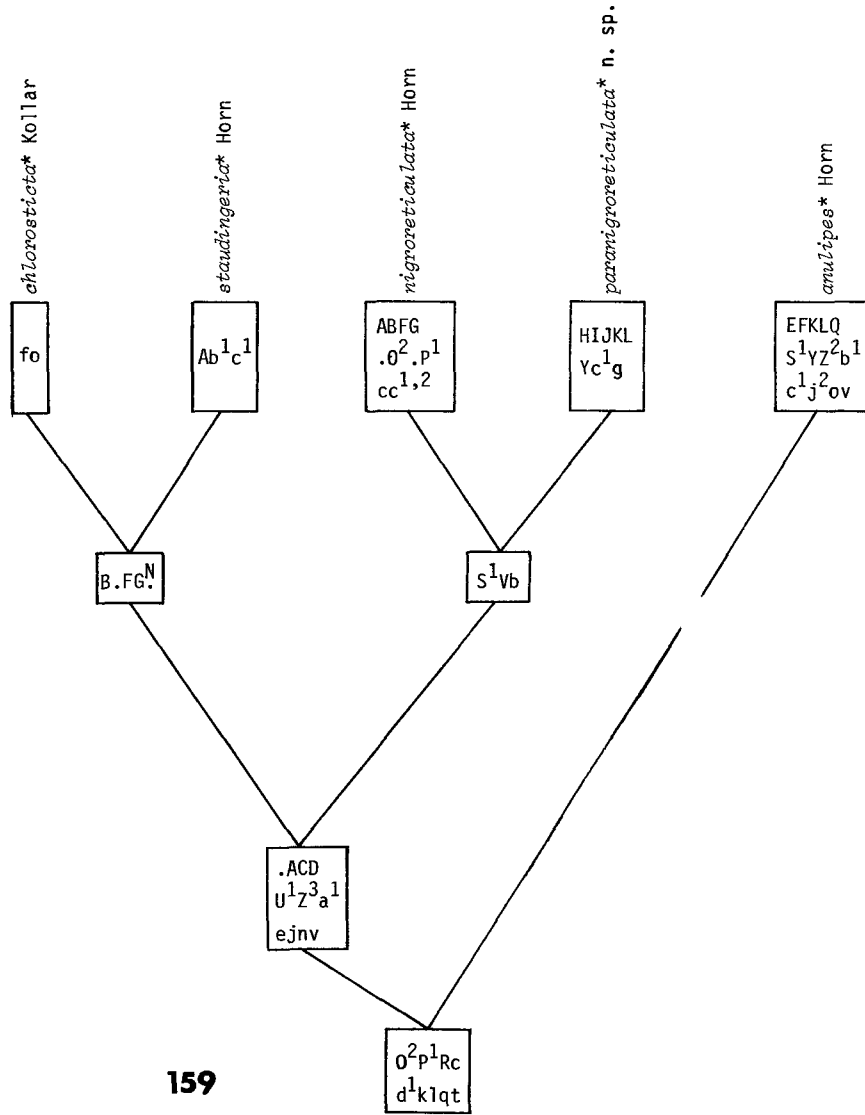


Fig. 159. Phylogenetic diagram for South American species of *Gaymara*. An asterisk indicates Brazilian species.

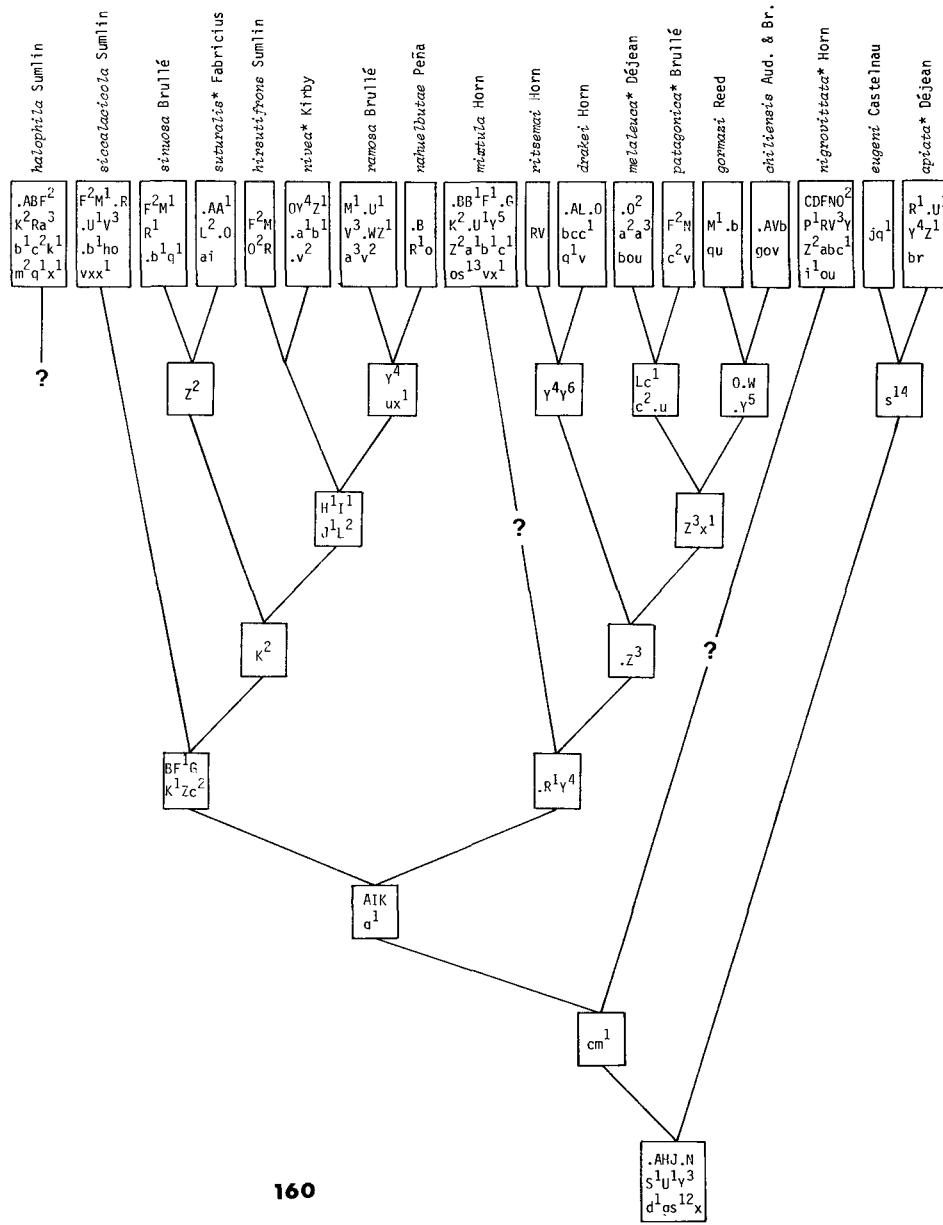


Fig. 160. Phylogenetic diagram for South American species of *Plectographa*. An asterisk indicates Brazilian species.

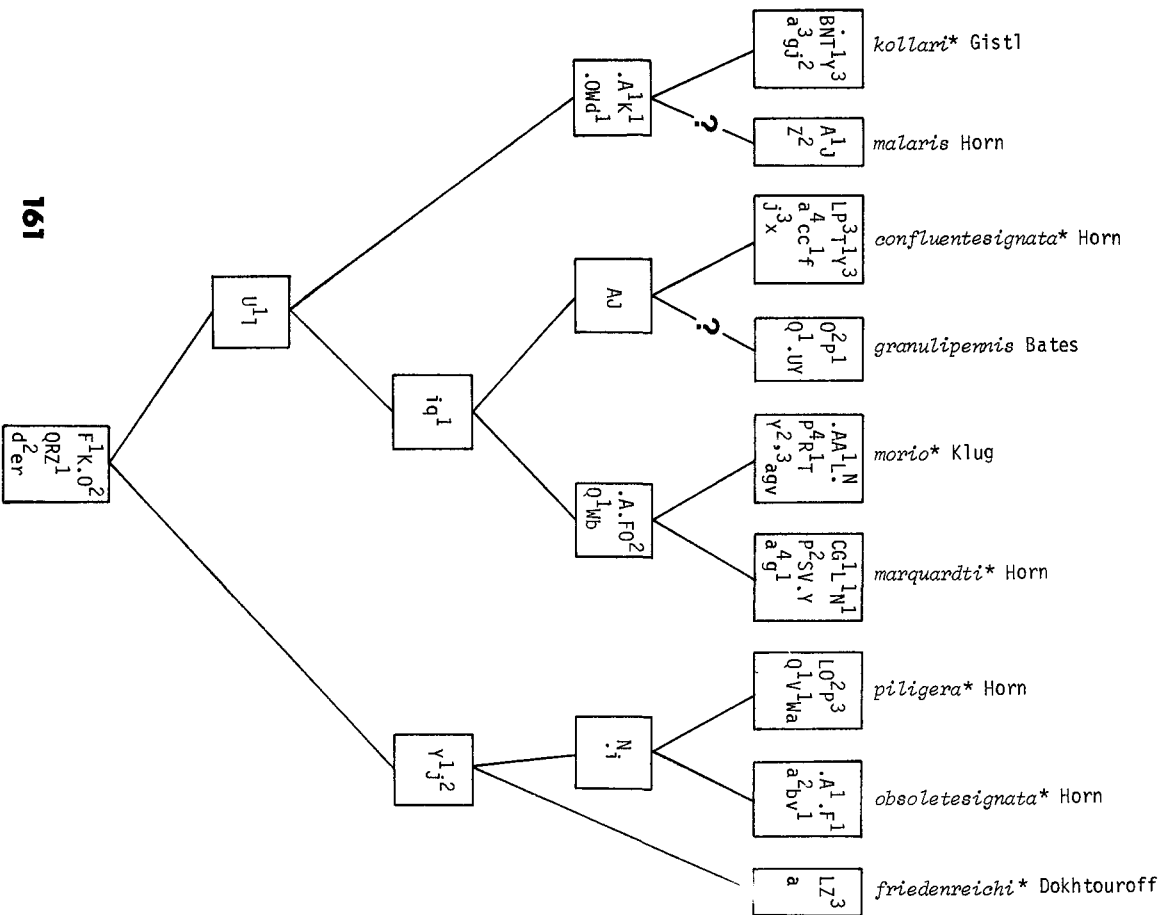


Fig. 161. Phylogenetic diagram for South American species of *Cylindera*. An asterisk indicates Brazilian species.

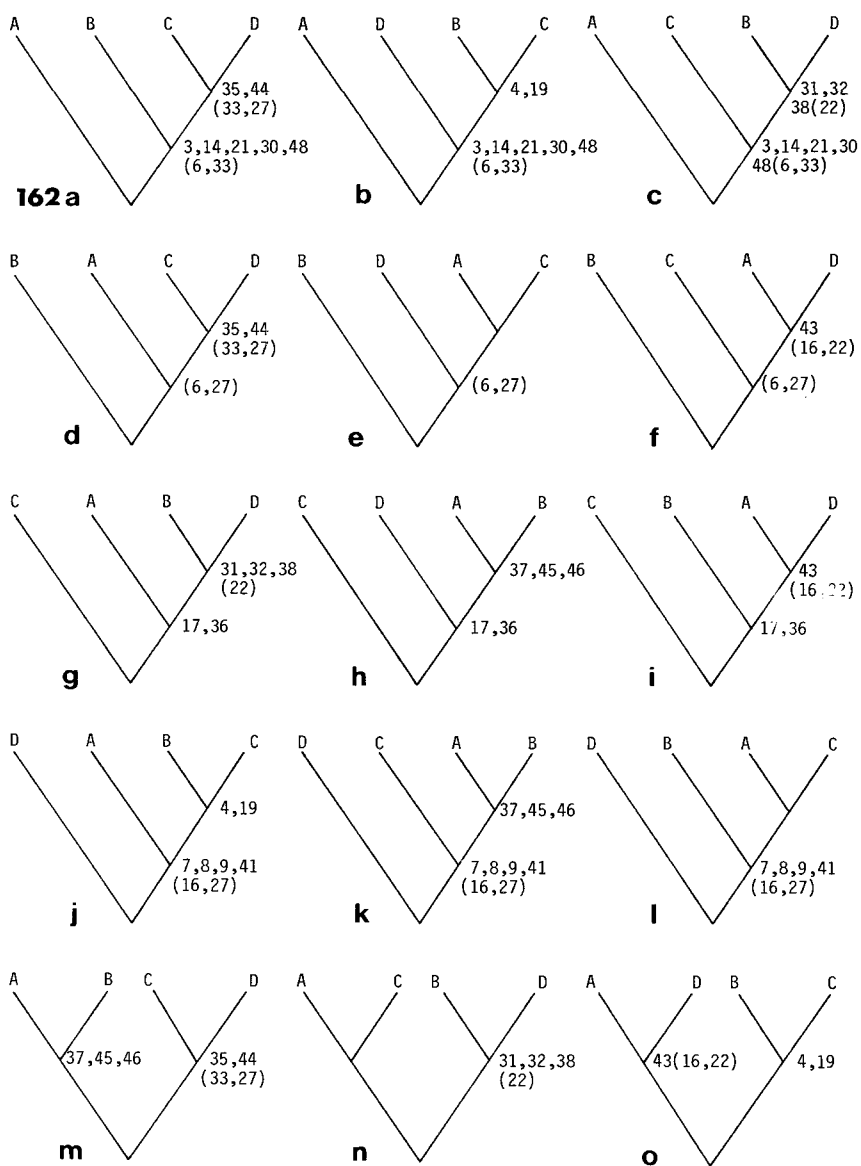


Fig. 162. Fifteen possible dichotomous cladograms for the four subgenera of Brazilian *Cicindela*, and characters in Table 3 for which apomorphous states are shared by members of each subgenus. Letters represent subgenera as follows: A - *Brasiella*, B - *Gaymara*, C - *Plectographa*, D - *Cylindera*. Numbers in brackets indicate gradient characters.

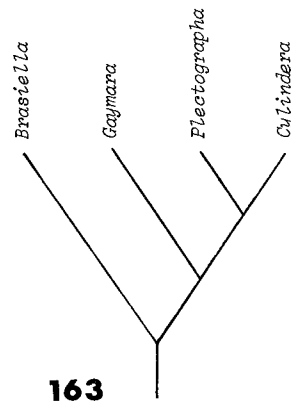


Fig. 163. Phylogenetic tree of the Brazilian subgenera of *Cicindela*.

Inter-group relationships are summarized in Table 3 and Figures 162 and 163. In the construction of Table 3, apomorphous states shared by subgenera, and those which occur in one or more species of a subgenus, were considered as having equal weight. Ideally apomorphous character states indicative of strong relationships are shared by all of most species of related subgenera. These apomorphous character states complement the less frequent apomorphous states. A broad pronotum and ventral sclerite with two elongate posterior projections are shared by most species of *Gaymara*, *Plectographa* and *Cylindera*. The absence of a flagellum and small stiffening rib characterize most species of *Brasiella* and *Gaymara*. All species of *Brasiella* and three of *Cylindera* lack a central plate, and most species of *Gaymara* and *Cylindera* have setae on the ventral sclerite and a membranous tooth.

As shown in Figure 162, of the 15 possible dichotomous cladograms for the four subgenera, either *a* or *c* probably indicates the true phylogeny because they each incorporate the largest number of synapomorphous character states, 11 in each. We favour cladogram *a* as it places the *Gaymara* lineage in an intermediate position between the *Brasiella* lineage and the *Plectographa/Cylindera* lineage, with which the former shares apomorphous character states of the genitalia approximately equally (Figs. 162a, m).

The subgenus *Brasiella* is a Neotropical autochthon that occupies mainly the northern half of South America and Central America where its origins and evolution undoubtedly took place. It is sister of the *Gaymara/Cylindera* lineage (Figs. 162a, 163). *Brasiella* seems to have retained a largely plesiomorphous habitus with several apomorphous acquisitions. The absence of a flagellum in the internal sac of the male is assumed to be an apomorphous state in *Brasiella*. It implies that earlier lineages

had a flagellum which was lost twice, once in *Brasiella* and again in *Gaymara*. If it is assumed that ancestors lacked a flagellum, which was then acquired by the *Plectographa/Cylindera* lineage parallel to and independent of other groups of tiger beetles, it is difficult to account for the complex form of this new flagellum. In more primitive subgenera of *Cicindela* the flagellum is almost straight, but in South American species it has 1.5 loops at the base. Thus we recognize the absence of the flagellum in *Brasiella* as being a loss of a somewhat specialized flagellum. Similarly the membranous oviduct prevalent in *Brasiella* is considered to be a loss of a well developed sclerotized one which is widespread in *Cicindela*.

The subgenus *Gaymara* is endemic to central-eastern South America. It is sister to the *Plectographa/Cylindera* lineage (Figs. 162a, 163). A narrow field-like strip or a membranous "tooth" of the internal sac of the male is present in most species of *Gaymara*, which is remarkably similar to the tooth with a spatulate apex found in species of *Plectographa*. Similarities of this degree are normally given a great deal of taxonomic weight, however, for these taxa it is difficult to conclude that these structures are homologues. If these structures are indeed synapomorphous the true genealogy is probably indicated by Figure 162c rather than Figure 162a.

The subgenus *Plectographa* is sister to subgenus *Cylindera* (Figs. 162a, 163). Most of its species are specialized in a number of characteristics including a broad and ragged pattern of the elytral maculations, and structure of male and female genitalia. This subgenus is endemic to the southern half of South America on both sides of the Andes. *Cicindela suturalis* which ranges from Brazil to the West Indies is the northernmost member of *Plectographa*.

The subgenus *Cylindera* is the only cosmopolitan South American subgenus of *Cicindela*. Most South American species of *Cylindera* live in central-eastern parts of that continent.

The relative age and origins of the subgenera are as follows: *Brasiella*, probable ancient Neotropical endemic, sister group of *Gaymara/Cylindera* lineage, originated in the northern half of South America and Middle America; *Gaymara*, South American endemic, sister group of the *Plectographa/Cylindera* lineage, with Brazilian origins south of the Amazon basin; *Plectographa*, sister group of *Cylindera*, South American endemic, origins in Argentina; *Cylindera*, highly diverse cosmopolitan complex, recent South American lineages probably originated in regions of southeastern Brazil.



## BIOGEOGRAPHY

### Introduction

Here we offer explanations of geographical distributions of extant taxa, their ancestral origins, and pathways taken to where they now live. This procedure combines current knowledge of geological and climatic history of the Neotropics, geographical distributions of the studied species, and their phylogenetic relationships.

### Assumptions

Our integration of these data is based on three assumptions. The first is that origins of South American subgenera of *Cicindela* preceded the Cenozoic Era, no later than early Cretaceous. In addition, early lineages and species groups diversified throughout the Tertiary Period, while extant species evolved during the late Pliocene and Pleistocene, beginning about 2 or 3 million years ago. With the exception of subgeneric origins, these time/lineage associations are in keeping with contemporary ground beetle studies (Ball, 1985; Noonan, 1985; Ball and Shpeley, 1986).

The second assumption is that there has been a general tendency in *Cicindela* for independent lineage adaptations to open country habitats in temperate and tropical regions (Cazier, 1954; Willis, 1967, 1972; Freitag, 1979; and articles in the journal *Cicindela* since 1969). Although riparian and woodland intrusion are plentiful in various groups, they appear to indicate the primitive and intermediate adaptive states respectively. This supports the "taxon cycle" concept demonstrated by carabids as reviewed by Erwin and Adis (1982), in which wetland generalists radiate into a biotic zone away from the waterside substratum and become evolutionary specialists. Specializations in savanna and prairie biomes have been major trends in a broad spectrum of lineages of *Cicindela*. As will be shown, the main distribution patterns of South American lineages of *Cicindela* are closely allied to savanna and open country conditions.

The third assumption is that speciation in *Cicindela* follows the allopatric mode as defined by Mayr (1963), that is geographic speciation. Important to this process are physical or climatic barriers, which isolate conspecific populations from one another, disrupt gene flow among them, and ultimately cause the formation of genetically incompatible separate species.

### Hypotheses

Current hypotheses that explain range distributions and geographical histories of South American organisms synthesize past geophysical, climatic, and biotic processes which appear to have had a general influence on their biogeography. (For reviews see Simpson and Haffer, 1978; Webb, 1978; and Haffer, 1981).

One such hypothesis is the Refuge Theory, which postulates that the biotic richness of tropical forests is created by changing vegetations due to climatic fluctuations (Prance, 1982; Mayr and O'Hara, 1986). A special kind of allopatric

speciation is therefore proposed in this theory which discards geophysical factors as part of the diversification process.

There is a growing body of evidence, however, that implies forest disturbance due to modern and past river dynamics is partially responsible for the high biological diversity in the upper Amazon basin (Salo *et al.*, 1986).

As stated by Haffer (1982) the Refuge Theory holds that forest and non-forest biomes changed continuously in distribution during the geological past, breaking up into isolated blocks and again expanding and coalescing under the varying humid to arid climatic conditions of certain geological time intervals, especially during the Quaternary.

Also important is the complex Tertiary geology of Central America. Unresolved are the time of the complete isthmian connection of North and South America and the extent of dry land within the sea gap before the continents were joined. The region appears to have served as island repositories for some evolving groups, and periodic crossings undoubtedly took place throughout the Tertiary, either by island hopping or across wide stretches of ocean. (Howden and Young, 1981, and Ball and Shpeley, 1986, discuss these problems in the light of beetle biogeography and provide references.)

Two hypotheses focus on biogeographic affinities of the Greater Antilles to other parts of the New World. One view, the vicariance model of Caribbean biogeography, is that tectonic forces, during the early or middle Tertiary, displaced portions of the Proto-Greater Antilles (land between North and South America) north-eastward to form the Greater Antilles, and that pieces of the original fauna were taken along as insular inhabitants (Rosen, 1975; Guyer and Savage, 1986).

The older dispersal model of Caribbean biogeography followed here proposes that dispersals from mainland coasts bordering the Caribbean region account for most of the fauna on the Greater Antilles. Records of offshore flights, up to distances of 100 miles by *C. trifasciata* (Erwin, 1979; Graves, 1981) and its wide geographical distribution in the West Indies (Leng and Mutchler, 1916; Elliott and Salbert, 1978); the presence of *C. marginata* in coastal eastern United States, Bahamas, and Cuba (Leng and Mutchler, 1916; Vaurie, 1952); and recent dispersals of *C. carthagena* from Central America or Colombia to Jamaica (Brouerius van Nidek, 1980; Freitag, 1985) and *C. olivacea* from Cuba to Florida (Woodruff and Graves, 1963) are evidence for the dispersal model and examples of the highly volant nature of adult *Cicindela*.

#### **Past Climatic, Floristic and Geophysical Processes**

Factors which very likely have had a bearing on the diversification of Neotropical taxa of *Cicindela* are: (1) formation of South America and its westward drift across the Pacific Ocean, following breakup of Gondwanaland in the late Cretaceous (Hallam, 1981); (2) proximal insular connection and eventual joining of North and South America through the Central American land bridge in the late

Table 4. Distribution of species of the subgenus *Brasiella* according to geographic area.\* †

Species	Geographic Area														
	Area No. 3	4	5	6	7	8	9	10	11	12	13	14	15		
	N. Argen.	SE. Brazil	Braz. Hghld.	W.Par. E.Bol.	Amazon R.Bol.	N.S. Amer.	N.W. Amer.	Lo.C. Amer.	Mexico Amer.	NW.Mex. SW.U.S.	W.I. Gr.Ant.	W.I. L.Ant.			
<i>viridicollis</i> group															
<i>cubana</i>												V			
<i>acutai</i>												V			
<i>viridicollis</i>												V			
<i>wickhami</i>											V				
<i>hemichrysea</i> group															
<i>menicula</i>						V	V	V	V						
<i>sphaerodera</i>								V	V						
<i>hemichrysea</i>								V	V	V					
<i>argentata</i> group															
<i>argentata</i>	V	V	V	V	V	V	V						V		
<i>venustula</i>							V								
<i>obscura</i>	V	V	V												
<i>pretiosa</i>															
<i>aureola</i> group															
<i>rivalieri</i>															
<i>amaenula</i>			V	V	V										
<i>aureola</i>	V	V	V	V	V										
<i>hori</i>													V		

(continued on next page)

Table 4 (continued)

Species	∅Area Area No.	N. Argen. 3	SE. Brazil 4	Braz. Hghld. 5	W.Par. E.Bol. 6	Amazon R.Bas. 7	N.S. Amer. 8	NW.S. Amer. 9	Lo.C. Amer. 10	Nuc.C. Amer. 11	Mexico 12	NW.Mex. SW.U.S. 13	W.I. Gr.Ant. 14	W.I. L.Ant. 15
<i>misella</i> group														
<i>dolosulaffinis</i>			V											
<i>tippmanni</i>			V											
<i>dolosula</i>		V	V	V	V	V		V	V					
<i>misella</i>				V	V			V	V	V				
<i>venezuelensis</i>							V							
<i>stamatovi</i> group														
<i>stamatovi</i>		V												
<i>minarum</i> group														
<i>hamulipenis</i>				V										
<i>brevipalpis</i>				V										
<i>banghaasi</i>				V										
<i>minarum</i>				V										
<i>nebulosa</i>								V	V	V				
<i>mandli</i>										V				
<i>insularis</i>							V							
<i>balzani</i>					V	V								
TOTAL	29	5(1)	6(2)	10(4)	7(1)	6(1)	6(4)	5	6	6(1)	1	1(1)	3(3)	1

\* Endemic species are shown in brackets.

+ References for Tables 4-7: Blackwelder (1944), Fernandez (1936), Mandl (1956, 1963, 1967, 1973), Peña and Barria (1973), Rivalier (1954, 1955), Sumlin (1979), Varas Arangua (1925), Vidal Sarmiento (1966b).

∅ See area description in Area section that follows.

⊙ Includes NE. Argentina, E. Paraguay, and Uruguay.

Tertiary; (3) presence of the Guayana and Brazilian shields, which have been above sea level since Paleozoic time (Haffer, 1981); (4) marine incursions in the Amazon basin from the Atlantic and Pacific Oceans during the early Tertiary (Haffer, 1981); (5) progressive Andean orogeny since the end of the Cretaceous, but principally that of the Pliocene and Quaternary that led to the emergence of lowlands immediately surrounding the Andes (Haffer, 1981); (6) origins of seasonal woodlands and savanna in Patagonia and their gradual spread in South America during the Tertiary and Quaternary (Webb, 1978); and (7) periodic expansions of non-forested areas into the Amazon basin caused by glacial episodes in the Pleistocene (Prance, 1982).

Cenozoic vegetational changes were related directly to cooler and drier climates. The Andean uplift and circulation patterns around 30° S latitude created a rain shadow in temperate South America, and ultimately contributed to the development of desert conditions inland and the driest east coast in the southern hemisphere (Furley and Newey, 1983). Central America and the Amazon basin were not greatly affected by cooling trends in the Tertiary, and a tropical rain forest dominated the land.

#### Expected Geographical Patterns

Given the above, certain geographical patterns may be expected, as follows: (1) a general fit of vicariance patterns, of any subgenus to the Cretaceous breakup of Gondwana, and of any species group to the coming together of North and South America and to the Guayana and Brazilian shields in the Tertiary; (2) grasslands and open forests to hold the largest number of species as demonstrated by Willis (1972) for North American *Cicindela*; (3) the Amazon basin to be a major region of diversification for Tertiary and Pleistocene lineages; (4) post-Pleistocene refugia or major species centers to be found outside of the Amazon basin.

#### Distribution and Historical Interpretation – Subgenera

Subgenera *Brasiella*, *Gaymara* and *Plectographa* are Neotropical endemics, and *Cylindera* is Cosmopolitan (Tables 4-7).

Of the first three, *Brasiella* occupies the northern half of South America, Middle America, and the West Indies, *Gaymara* is confined to eastern South America, and *Plectographa* ranges across South America from central Chile and western Patagonia to the West Indies. Subgenus *Cylindera* in South America is confined mainly to Brazil south of the Amazon basin. This subgenus is part of a complex the members of which Rivalier (1950, 1954, 1957, 1961, 1963) treated as subgenera within the genus *Cylindera*. Subgenus *Cylindera s. str.* ranges in both the Old and New Worlds and other members are found in temperate and tropical regions of the Old World (Fig. 164; Table 7).

The reconstructed phylogeny (Fig. 163) shows three dichotomies (divergences): *Brasiella* and lineage *Gaymara - Plectographa - Cylindera*; *Gaymara* and lineage *Plectographa - Cylindera*; and *Plectographa* and *Cylindera*.

The collective distributional pattern of the four subgenera suggests a Gondwanan ancestry. Divergence-spatial relationships among ancestral lineages are obscure as the four subgenera are more or less sympatric in South America. The geographical ranges of *Plectographa* and *Cylindera* might indicate a south-north division of their immediate ancestor in western Gondwanaland.

Concerning the cosmopolitan geography of *Cylindera*, we propose that the break-up of Gondwanaland in the Cretaceous was the initial cause of its disjunctions in the southern hemisphere, that is between South America and Africa, followed by late Cretaceous dispersal from South America into North America, and from Africa into Eurasia during the early and middle Tertiary. (See Hallam, 1981, for a review of plate movement, eustasy, climate, and organic response to them since the early Mesozoic, as background information for the above hypothesis.)

#### **Distribution and Historical Interpretation – Species Groups and Species**

*Ecological Notes.*— Species of *Cicindela* in the Neotropics and elsewhere occupy similar habitats. Ecological requirements are specific and diverse among taxa, though water availability and soil types are principal factors in governing geographical distributions of species. As a group, members of *Cicindela* are ground residents living in open places in most biomes. Common habitat sites are roadsides, paths in forests, banks of rivers and streams, edges of lakes, ponds, sea beaches and salt marshes, and fields such as grasslands, pastures and salt playas. A few species inhabit mountains, deserts, and low wetlands.

Species of *Cicindela* found in the Amazon River basin are largely ecological generalists. The majority of these species are found in other areas as well. Tiger beetles typical of tropical rain forests such as those of *Odontocheila* and *Ctenostoma*, are arboreal, but species of *Cicindela* are obligate terrestrial forms unsuited to dense forests and long and frequent periods of flooding, characteristic of the Amazon lowlands. Nonetheless the fact that widespread and relict species of *Cicindela* exist in the Amazon River basin indicates a history of establishments there.

Data available for 17 (29%) of 61 species studied indicate spatial patterns of habitat type or habitat factor preference.

Adults of insular and mainland species of the *C. viridicollis* species group (*Brasiella*) are found on patches of bare ground and in dry grasslands. Adults of *C. argentata* are found in moist grassy places and on river beaches.

Adults of sister species *C. melaleuca*/*C. patagonica* (*Plectographa*) are found on sea coasts. The former species lives near marshes and dry places inland as well. Three additional species of *Plectographa* are seashore residents and adults of one other have been collected on salt playas. Adults of *C. suturalis* are riparian. The habitats of these species, one third of a total of 18 species, in this subgenus, suggest seaside origins and early development for salt tolerance in *Plectographa*.

Table 5. Distribution of species of the subgenus *Gaymara* according to geographic area.\*

Species	Area	S.E. Brazil**	Braz. Hghld.	Amazon R. Basin
	Area No.	4	5	7
<i>chlorosticta</i> group				
<i>chlorosticta</i>		V	V	V
<i>staudingeria</i>		V	V	V
<i>nigroreticulata</i>		V		
<i>paranigroreticulata</i>		V		
<i>anulipes</i> group				
<i>anulipes</i>		V	V	
TOTAL	5	5(2)	3	2

\*Endemic species are shown in brackets.

\*\*Includes NE. Argentina, E. Paraguay, and Uruguay.

Three species of *Cylindera* are riparian which may be characteristic of the habitats for other species of this subgenus.

The majority of Neotropical taxa of *Cicindela* live in places between sea level and 1500 meters, and a few others live at higher elevations up to 3500 meters.

Taxa of most South American species of *Cicindela* are active in summer in the southern hemisphere, appearing anytime from October to April. Taxa within southern parts of the Amazon River basin are also active in "summer". Taxa north of the basin appear to be active during summer of the northern hemisphere, while those that transcend the basin are active all year emerging in warmer seasons of both hemispheres. We have not overlooked the importance of these findings to investigations of speciation and evolution of *Cicindela* in the tropics. An analysis is beyond the scope of this study however, and for now we refer to the phenomenon as "Hemispheric Control of Phenological Activity in Tropical Regions".

*Areas.*— Fifteen geographical areas are designated as a basis for analysis of distribution patterns. They are delimited by assemblages of taxa of *Cicindela* or where geographical limits of taxa of *Cicindela* are congruent. Brief accounts of the areas follow (taken from Bates, 1961; Garrett, 1981; and Furley and Newey, 1983). Area numbers are listed with their representative taxa in Tables 4-8.

Table 6. Distribution of species of the subgenus *Plectographa* according to geographic area.\*

Species	Area	C. Chile	S. Argen.	N. Argen.	S.E.	Braz.	W. Par.	Amazon	N.S.	NW. S.	W.I.	W.I.
	Area No.	1	2	3	Brazil** 4	Hghld. 5	E. Bol. 6	R. Bas. 7	Amer. 8	Amer. 9	Gr. Ant. 14	L. Ant. 15
<i>halophila</i> group												
<i>halophila</i>				V								
<i>suturalis</i> group												
<i>siccalacicola</i>				V								
<i>sinuosa</i>				V	V							
<i>suturalis</i>					V	V	V	V	V	V	V	V
<i>hirsutifrons</i>				V								
<i>nivea</i>			V	V	V	V						
<i>ramosa</i>				V	V							
<i>nahuelbutae</i>		V										
<i>melaleuca</i> group												
<i>mixtula</i>				V			V					
<i>ritsemai</i>				V								
<i>drakei</i>				V								
<i>melaleuca</i>				V	V							
<i>patagonica</i>				V	V							
<i>gormazi</i>		V	V									

(continued on next page)



Table 6 (continued)

Species	Area	C. Chile	S. Argen.	N. Argen.	S.E.	Braz.	W. Par.	Amazon	N.S.	NW. S.	W.I.	W.I.
	Area No.	1	2	3	Brazil**	Hghld.	E. Bol.	R. Bas.	Amer.	Amer.	Gr. Ant.	L. Ant.
<i>chiliensis</i>		V	V									
<i>nigrovittata</i> group												
<i>nigrovittata</i>						V						
<i>apiata</i> group												
<i>eugeni</i>				V								
<i>apiata</i>				V	V	V	V					
TOTAL		3(1)	3	13(6)	7	4(1)	3	1	1	1	1	1
	18											

\*Endemic species are shown in brackets.

\*\*Includes NE. Argentina, E. Paraguay, and Uruguay.

Table 7. Distribution of species of the subgenus *Cylindera* s. str. in South and North America, and *Cylindera* and groups or subgenera elsewhere.\*

Species	Area	N. Argen.	S.E. Brazil**	Braz. Hghld.	Amazon R. Bas.	Mexico	Nearctic (Can., U.S.A.)	Palaearctic	Ethiopian	Oriental	Australia
	Area No.	3	4	5	7						
<i>morio</i> group											
<i>kollari</i>				V	V						
<i>malaris</i>					V						
<i>confluentesignata</i>			V	V							
<i>granulipennis</i>					V						
<i>morio</i>				V	V						
<i>marquardtii</i>				V							
<i>friedenreichi</i> group											
<i>piligera</i>				V	V						
<i>obsoletesignata</i>		V	V								
<i>friedenreichi</i>			V								
other species						5	6	20,3+	13,3+	59,9+	1
<b>TOTAL</b>	9*	1	3(1)	5	5(2)	5	6	20	13	59	1

\*Endemic species are shown in brackets.

\*\*Includes NE. Argentina, E. Paraguay, and Uruguay.

+Note second number indicates number of species groups or "subgenera" within or closely related to *Cylindera* s. str. from Rivalier (1950,1954,1957,1961,1963).

\*Not including other species.

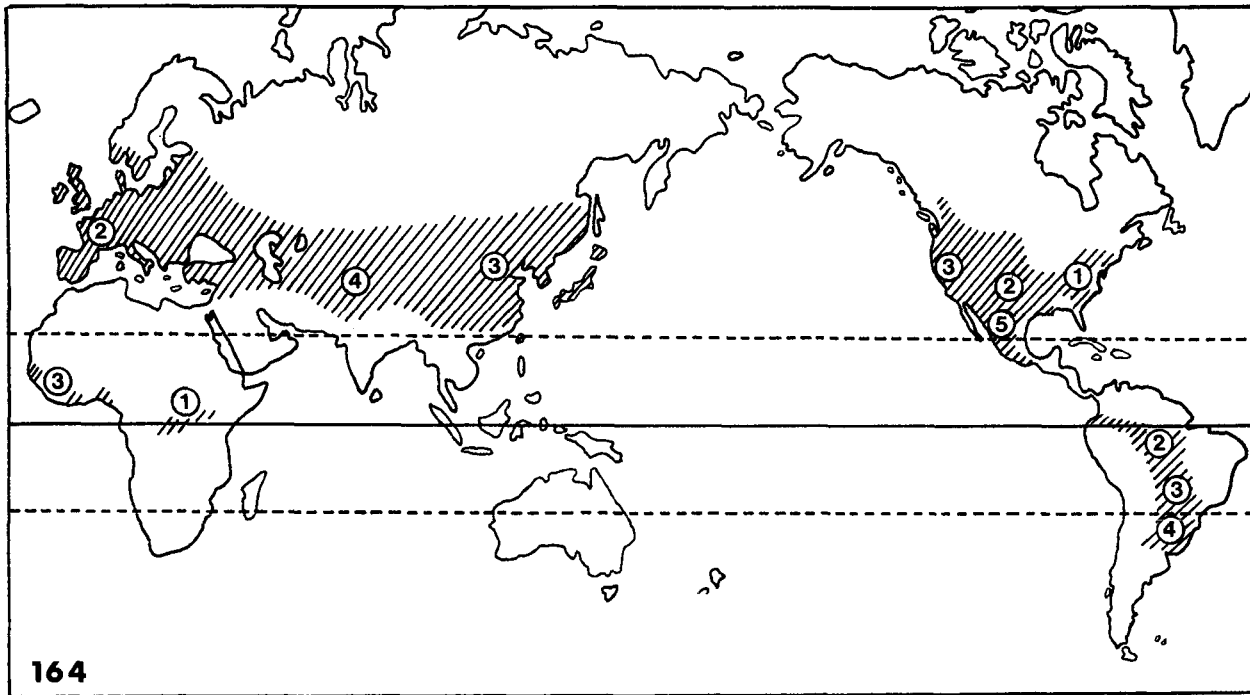


Fig. 164. Distribution of subgenus and species *Cylindera* s. str.

1. Central Chile: Bordered by the west coast and high Andes this is a relatively wet area, south of the Atacama Desert, and consists of coastal forests, eastern upland taiga or tundra, and dry low scrubland in the north. Ball and Shpeley (1986) use the term 'Southern Trans-Andean South America' for this area.

2. Southern Argentina: This area, temperate Patagonia north to approximately Rio Negro, is bordered by the Andes in the west and the east coast. The area is marked by dry western uplands and admixtures of desert, semi-desert and grasslands in central and eastern parts.

3. Northern Argentina: This is the Pampas area. It is bordered by the Andes to the west, the Rio Negro to the south and the east coast. The northern boundary includes Chaco Central and Entre Rios. This is predominantly a grassland region. Semideciduous forests are present in the north.

4. Southern Brazil: This area includes the Brazilian states south of São Paulo, Uruguay, northern Argentina, and eastern Paraguay. The east coast, Entre Rios and Rio Paraguay form the main boundaries. There is no distinct northern boundary. Northern uplands gradually merge with those in the south end of area 5. The vegetational zones are primarily coastal rain forests, prairies to the south, and semideciduous forests to the north.

5. Eastern Brazil (Brazilian Highlands, Brazilian Shield): This vast region to the south of the Amazon River basin, includes the east coast, eastern highlands, and central uplands of Brazil. Western boundaries are Rio Araguaia, the pantanal complex and Rio Paraguay. Semideciduous forests and savanna scrub cover much of this area. Amazonian gallery forests along river valleys extend from the south end of the Amazon basin into northern parts of this area, and extensive rain forests are found on the east coast.

6. Western Paraguay and Eastern Bolivia: This area comprises the Chaco region of both countries and the eastern Bolivian uplands, and is bordered by the Andes to the west, Rio Paraguay to the east, Rio Guaporé to the north, and Chaco central to the south. The region is relatively dry dominated by savanna scrub, and semideciduous forests in central Bolivia, and large river valleys.

7. Amazon River Basin: The area consists of the large upper and main drainage systems of the Amazon River in northern Brazil. A more or less continuous rain forest covers the area. Savanna scrub elements intrude southern and northwestern regions of the basin from areas 5, 6 and 8.

8. Northern South America (Guayana Shield): This area includes the Guayana Highlands, Orinoco River basin, northeastern Colombia, and the north coast of South America. The Andes proper and Cordillera Oriental just west of the Maracaibo basin form the designated western border of this area. Savanna scrub covers western portions. Rain forests and grasslands cover central and eastern parts.

9. Northwestern South America: This area includes Colombia and Ecuador in and west of the Andes. No endemic species of *Cicindela* are found there but geographical ranges of a few species terminate in it. Coastal rain forests and upland

semideciduous forests are widespread, and smaller zones of savanna scrub are present near the Caribbean coast of northern Colombia and Pacific coast of southern Ecuador. Ball and Shpeley (1986) refer to this area as 'Northern Trans-Andean South America'.

10. Lower Central America: This area includes Costa Rica and Panama. A series of islands may have persisted in this area from the mid-Tertiary up until the late Pleistocene. The topography is mixed and consists of central mountains and lowlands. Tropical rain forest is widespread. West of the mountains on the Pacific slope, rainfall and floral richness are reduced.

11. Nuclear Central America: Most of this area, between the Isthmus of Tehuantepec and southern Nicaragua, has been dry land throughout the Tertiary (Rosen, 1978), but periodically separated from Mexico (area 12) by high sea levels (Ball and Shpeley, 1986).

12. Mexico north of the Isthmus of Tehuantepec.

13. Northwestern Mexico and Southwestern United States.

14. West Indies: Greater Antilles.

15. West Indies: Lesser Antilles.

Undesignated areas which are devoid of species are the dry west coast from southern Ecuador to northern Chile, high Andes, and the southern end of Argentina and Chile.

*The Distributional Pattern.*— Five of the seven *Brasiella* species groups designated, reside chiefly within the northern half of South America (Table 4). Of these, species groups *aureola* and *stamatovi* are endemic to the continent (areas 3-8, and 3 respectively), species groups *minarum* and *misella*, extend into Middle America (areas 3-11), and species group *argentata* is also found in southern islands of the Lesser Antilles (areas 3-9, 15). Of the two remaining *Brasiella* species groups, *hemichrysea* group is primarily Middle American (areas 9-12), and *viridicollis* group is broadly disjunct being present both in Cuba (area 14), and northwestern Mexico and southwestern United States (areas 12, 13). Thus in terms of *Brasiella* species groups the greatest diversity is in the northern half of South America.

The 29 species of *Brasiella* collectively range from northern Argentina to southwestern United States and the West Indies (Table 4). Of the 22 species known from South America, 12 are found south of the Amazon River basin (areas 3-6), four are within or on the edge of the basin (area 7), and six inhabit northern and northwestern South America (areas 8-9). Among the remaining seven species, three are confined to Central America and southern Mexico (areas 10-12), one inhabits northwestern México and southwestern United States (area 13), and three species are found in Cuba (area 14).

The pattern of diversity comprises chiefly two species aggregates in South America. One, south of the Amazon River basin (areas 4-6) diminishes in species number abruptly southward and gradually northward and eastward. A smaller

species aggregate north of the basin is confined largely by the Guayana Highlands and the Andes (area 8).

In closer scrutiny, of the 12 species south of the Amazon River basin four have substantial geographical ranges. The species *C. amaenula* and *aureola* are each widely disjunct with isolated populations in the basin (Fig. 49), *C. obscurella* ranges into southern Uruguay and northern Argentina (Fig. 48), and *C. minarum* is found from near the coast to the Vacaria River area in Matto Grosso (Fig. 51). The remaining eight species have restricted or disjunct ranges. They are *C. horioni* (Bolivia), *C. balzani* (Bolivia, Ecuador), both on the margins of the Amazon basin, *C. dolosulaffinis* and *C. tippmanni* (Paraguay), *C. stamatovi* (northwestern Argentina), and *C. banghaasi*, *C. brevipalpis* and *C. hamulipenis* (southeastern Brazil) (Fig. 51). The species *C. dolosula* and *C. misella* are found south, north and northwest of the Amazon basin and occur in parts of Central America (Fig. 50).

The Amazon River basin is occupied by one widespread species and one local species. The species *C. argentata* is the only species of *Cicindela* found in the arid northeastern parts of area 5, and it extends into the Caribbean region (Fig. 47). The species *C. pretiosa* is found only in the Manaus area (Fig. 48).

Among the six species that inhabit the region north and northwest of the Amazon River basin those with comparatively larger geographical ranges, *C. mendicula* (Nicaragua to western Venezuela) and *C. nebulosa* (Nicaragua to Colombia and Ecuador), are found in Central America and *C. venustula* occupies the region north of the Guayana Highlands. The species *C. rivalieri* and *C. venezuelensis* are confined to small areas in Venezuela, and *C. insularis* is found in Trinidad and on the adjacent mainland.

Two species have local distributions in Central America and southern México, *C. sphaerodera* in the Quiché Mountains of Guatemala and *C. mandli* in Chiapas, México. *C. hemichrysea* ranges more widely from western México to Panamá. In the north *C. wickhami* inhabits northwestern México and southwestern United States, and *C. acuniai*, *C. cubana* and *C. viridicollis* occupy Cuba.

Nine species are endemic in the southern end of the *Brasiella* range, eight may be geographical relicts (Table 4). Four endemic species are found north of the Amazon River basin. Three of them are probably geographical relicts. At the northern end of the range there is one mainland endemic species, and three species, very likely autochthonous, on Cuba. Only one endemic species is present in Central America.

These findings indicate that the region south and southeast of the Amazon River basin (areas 4-6) has been the chief center of diversification for *Brasiella*. A smaller region north of the basin (area 8) has been a minor center.

The only two species groups of subgenus *Gaymara*, *chlorosticta* and *anulipes*, are found in eastern South America. The species have a composite range mainly in Brazil south of the Amazon River basin (areas 4-5) (Table 5). The area of greatest diversity is Rio Grande do Sul (area 4) in which at least three and probably all five

species exist (Fig. 77). Three species, *C. chlorosticta*, *C. staudingeria* and *C. anulipes*, are comparatively widespread and enter the southern margins of the Amazon River basin (area 7). Two species, *C. nigroreticulata* and *C. paranigroreticulata*, appear to have local ranges.

It is concluded from these data that the major center of diversity for *Gaymara* has been southeastern Brazil (area 4).

Of subgenus *Plectographa*, species groups *suturalis*, *melaleuca* and *apiata*, range largely within northern Argentina (area 3). Species group *halophila* is endemic there, and species group *nigrovittata*, is endemic to southeastern Brazil (area 5). Species group diversity in *Plectographa* is therefore greatest in northern Argentina (Table 6).

The composite geographical range for the 18 *Plectographa* species covers most of South America from temperate Chile and Patagonia to the north coast and West Indies (Table 6). Thirteen species are resident in northern Argentina (area 3); three species are known from Chile (area 1); one species is found in eastern Brazil (area 5); and one species is widespread in the northern half of South America and the West Indies (areas 4-8, 15).

The pattern of diversity consists principally of a large species aggregate in northern Argentina. Species decline in number from this region, abruptly northward and southward, but more gradually eastward.

Of the 13 species in northern Argentina three, *C. drakei*, *C. ritesmai* and *C. mixtula* are found in the west end of this region and the latter species also inhabits Bolivia and possibly western Paraguay. Three species *C. siccalacicola*, *C. hirsutifrons* and *C. eugeni* appear to have restricted ranges, mainly in Cordoba. Intrusions into the eastern portions of northern Argentina, or Paraguay, Uruguay, and southeastern Brazil have been made by *C. halophila*, *C. sinuosa*, *C. ramosa*, *C. melaleuca* (Fig. 113), and *C. apiata* (Fig. 114). The species *C. patagonica* seems to be confined to Rio Grande do Sul, Buenos Aires and southern Uruguay (Fig. 113). The coastal species *C. nivea* ranges from Patagonia to Brazil (Fig. 112).

Of the three Chilean species, *C. nahuelbutae* is found locally in Arauco Province, and *C. chiliensis*, and *C. gormazi* extend into southwestern Argentina.

The species *C. nigrovittata* inhabits a small area in eastern Brazil (Fig. 114), and *C. suturalis* is widespread north of Argentina (Fig. 112).

These data show that all or part of the geographical ranges of 13 species are located in the northern half of Argentina (area 3), and two others in southwestern Argentina (area 2). Only three species live entirely outside of northern Argentina. In terms of endemism, six species are located in northern Argentina (area 3), in which three are geographical relicts. One species is endemic to Chile (area 1) and another to eastern Brazil (area 5), both are geographical relicts.

This leads us to conclude that northern Argentina has been the major center of diversity for *Plectographa*.

South American species groups of subgenus *Cylindera*, *morio* and *friedenreichi*, are endemic to the northern half of South America, and occupy mainly southeastern and eastern Brazil (areas 4, 5), Amazon basin (area 7), and marginally, northern Argentina (area 3).

As a group the nine species of South American *Cylindera* range across the middle area of the continent south of the Amazon River from southeastern Brazil to Ecuador and Peru (Table 7). Six species are found in southeastern Brazil (areas 4, 5). One species is found both in southeastern Brazil and Ecuador (areas 5, 7). One species is found in Ecuador (area 7), and one other in Peru (area 7).

The pattern of species diversity consists of a broad aggregate in southeastern Brazil and three isolated taxa in western South America.

Of the seven species found in southeastern Brazil, *C. kollari* and *C. morio* enter southern parts of the Amazon River basin (Figs. 155, 156), *C. confluentesignata* ranges near the coast into Uruguay (Fig. 155), *C. marquardtii* is found in Matto Grosso (Fig. 156), *C. friedenreichi* exists as a small isolated population at the south end of this region in Rio Grande do Sul (Fig. 157), *C. piligera* is widely disjunct, found only in Minas Gerais and Ecuador (Fig. 157), and *C. obsoletesignata* ranges into southern Paraguay and northern Argentina (Fig. 157).

The non-Brazilian species *C. granulipennis* and *C. malaris* found in Ecuador and Peru respectively, along with the Ecuadoran *C. piligera* population, represent western area 7 (Amazon basin) isolates of South American *Cylindera*. None of these three taxa appears to exist west of the Andes.

Based on these data we conclude that the major center of diversity for taxa of South American *Cylindera* has been southeastern Brazil (areas 4, 5).

Geographical distributions of species per designated area and endemism of species for the four subgenera collectively indicate a consistent pattern (Table 8, Fig. 165). Northern Argentina (area 3), southeastern Brazil (area 4) and eastern Brazil (area 5) are the major centers of taxa concentration. They contain the largest number of species, about 20 in each area.

Together these areas also contain the largest number of endemic species determined, 17 (54%) of a maximum number of 31 found in all designated areas. Endemism based on species found only in each area is remarkably high, 37% for area 3, 24% for area 4, and 23% for area 5. Fourteen species are found in the Amazon River basin (area 7), and three species (21%) are endemic. Next in importance is northern South America (area 8), in which four (57%) of seven species are endemic. Northwestern South America (area 9) and lower Central America (area 10), each containing six species, are noted for their lack of endemic species. Nuclear Central America (area 11) contains six species including one endemic (17%). Three species are endemic to Cuba, (area 14). One endemic species (10%) of 10 is found in area 6. Other areas (1,2,12,13,15) with three or fewer species have one or no endemic species.



Table 8. Number of species and endemic species of subgenera *Brasiella*, *Gaymara*, *Plectographa*, and *Cylindera* for designated geographical areas.

Taxa	Geographical Area															Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Species	3	3	19	21	22	10	14	7	6	6	6	1	1	4	2	–
Endemic Species	1	–	7	5	5	1	3	4	–	–	1	–	1	3	–	31

#### Phylogenetic - Geographical Relationships and Areas of Diversification

Allopatric patterns of sister lineages, derived in the phylogenetic section, are important to the identification of geographical origins and regions of diversification. Figure 166 and Tables 9-12 show comparative geographical positions for sister lineages of the studied subgenera. Geographical areas 1 to 15 are the basis for allopatric reference. Allopatric states of sister taxa between and within the same geographical area are included.

Beginning with subgenus *Brasiella* (Table 9), two pairs of early sister lineages have allopatric members. One pair is divided between areas 7 and 9 with a small overlap in area 8. Another pair is allopatric in area 12.

Within species groups there are allopatric members in 13 sister lineages. Based on nearest areas of these disjunct sister lineages, the area combinations are, three 7/8, two 5/5, two 11/11, and one each of 5/7, 5/9, 6/7, 5/6 or 7/9, 8/11, and 13/14.

Concerning individual areas alone, nine are associated with allopatric sister lineages in *Brasiella*. The areas with their respective number of allopatric associations shown in brackets are as follows: area 7 (7), area 5(5), area 8(4), area 11(3), area 9(3), area 6(2), area 12(1), area 13(1), and area 14(1).

For *Brasiella* lineages then, the main areas in and among which diversification has occurred are the Amazon River basin (area 7), eastern Brazil (area 5), northern Brazil (area 8), and the junction of Central and South America (area 9 to 11) (Fig. 116).

With the exception of *C. nigroreticulata*/*C. paranigroreticulata*, all members of sister lineages in *Gaymara* are sympatric in areas 4, 5 or 7 (Table 10). The former sister species are allopatric in central parts of southwestern Brazil (area 4) which probably has been the principal area of diversification for the subgenus as the other three species of *Gaymara* exist there as well.

Members of three pairs of *Plectographa* sister lineages are allopatric (Table 11). Their nearest area combinations are 3/1, 3/1 or 2, and 3/4. Area 3 is associated with all three allopatric combinations, and sympatric sister lineages are most frequently found there. Thus we conclude that diversification of the majority of *Plectographa* lineages has taken place in or adjacent to northern Argentina (area 3).

Four pairs of *Cylindera* sister species have allopatric members (Table 12), for which nearest area combinations are 3 or 4/5, 7, 4/4, 4 or 5/7, and 7/7. Based on these data diversification of *Cylindera* lineages has been prominent in or among the Amazon River basin (area 7), southwestern Brazil (area 4), and eastern Brazil (area 5).

As expected, among the principal centers of species diversification the Amazon basin appears to have played a major role, particularly during the Pleistocene. Additional evidence of late Pleistocene effects are the small refugia on the eastern slopes of the Andes along the edges of the Amazon basin, in Bolivia, Peru, and Ecuador. A few species appear to be wedged between the high mountain and rainforest barriers (*i.e.*, *C. balzani*, *C. granulipennis*, *C. horioni*, *C. malaris*, and western populations of *C. piligera*).

There is at least one small refugium within the basin near Manaus, that of *C. pretiosa*, and isolated populations of *C. amaenula* and *C. aureola*.

Sister groups residing on opposite sides of the Amazon basin are evidence of Amazonian disruptions of widespread ancestral lineages, as for example *C. minaum/nebulosa-mandli-insularis*.

### Geographical History

Historical aspects of geography for taxa of the four subgenera are pieced together from the above reconstructed phylogeny, assumptions, hypotheses, evidence for past climates and geophysical processes of the Neotropics, and distribution patterns of related and unrelated taxa.

We propose the following events for *Brasiella*. (1) Early Tertiary vicariations of early lineages caused by marine incursions in the Amazon basin, and founder dispersals over tropical forests in developing open forest and savanna, resulting in diversification of ancestral stocks into *cubana-pretiosa* lineage, *aureola* group, *misella* group, *stamatovi* group, and *minarum* group. (2) Early Tertiary vicariance of *cubana-pretiosa* lineage and its diversification into ancestors of northern South American (Guayana Shield, area 8) *cubana-hemichrysea* lineage and eastern Brazil (Brazilian Shield, area 5) *argentata* group. (3) Diversification of *cubana-hemichrysea* lineage in northern South America, and a middle Tertiary ocean crossing to Central America resulting in North American *viridicollis* group and South American stock of *hemichrysea* group. (4) Dispersal into northern México and diversification of *viridicollis* group, a late Tertiary ocean crossing to Cuba from eastern México or the United States by *cubana-viridicollis* lineage and its Pleistocene diversification on Cuba, and extinctions of southern and eastern

Table 9. Phylogenetic - distributional relationships of *Brasiella* sister lineages.

Sister Lineages	Geographical Areas	Distributional Relationships of Lineages
<b>Species Groups</b>		
<i>C. viridicollis</i> group		
<i>C. acuniai/C. viridicollis</i>	14	sympatric
<i>C. cubana/acuniai-viridicollis</i>	14	sympatric
<i>C. wickhami/cubana-acuniai-viridicollis</i>	12-13/14	allopatric
<i>C. hemichrysea</i> group		
<i>C. mendicula/C. sphaerodera</i>	8-9-11/11	allopatric
<i>C. hemichrysea/mendicula-sphaerodera</i>	10-11-12/8-9-11	sympatric
<i>C. argentata</i> group		
<i>C. obscurella/C. pretiosa</i>	4-5/7	allopatric
<i>C. venustula/obscurella-pretiosa</i>	8/4-5-7	allopatric
<i>C. argentata/venustula-obscurella-pretiosa</i>	3 to 8/4-5-7-8	sympatric
<i>C. aureola</i> group		
<i>C. aureola/C. horioni</i>	3-4-5-7/6	allopatric
<i>C. amaenula/aureola-horioni</i>	5-6-7/3 to 7	sympatric
<i>C. rivalieri/amaenula-aureola-horioni</i>	8/3 to 7	allopatric
<i>C. misella</i> group		
<i>C. dolosulaffinis/C. tippmanni</i>	4/4	sympatric
<i>C. dolosula/C. misella</i>	3 to 7-9-10/6-7-9-10-11	sympatric
<i>C. venezuelensis/dolosula-misella</i>	8/3 to 7-9-10-11	allopatric
<i>dolosulaffinis-tippmanni/venezuelensis-dolosula-misella</i>	4/3 to 10	sympatric

(continued on next page)

Table 9 (continued)

Sister Lineages	Geographical Areas	Distributional Relationships of Lineages
<i>C. stamatovi</i> group		
<i>C. stamatovi</i>	3	
<i>C. minarum</i> group		
<i>C. hamulipenis/C. brevipalpus</i>	5/5	allopatric
<i>C. banghaasi/hamulipenis-brevipalpus</i>	5/5-5	allopatric
<i>C. mandli/C. insularis</i>	11/8	allopatric
<i>C. nebulosa/mandli-insularis</i>	9-10-11/8-11	allopatric
<i>C. minarum/nebulosa-mandli-insularis</i>	5/8 to 11	allopatric
<i>C. balzani/minarum-nebulosa-mandli-insularis</i>	6-7/5-8 to 11	allopatric
<i>hamulipenis-brevipalpus-banghaasi/</i> <i>balzani-minarum-nebulosa-mandli-insularis</i>	5/5-11	sympatric
Early Lineages		
<i>cubana-wickhami/mendicula-hemichrysea</i>	12-13-14/8 to 12	allopatric excl. 12
<i>cubana-hemichrysea/argentata-pretiosa</i>	8 to 14/3 to 8	allopatric excl. 8
<i>cubana-pretiosa/rivalieri-horioni</i>	3 to 14/3 to 8	sympatric
<i>cubana-horioni/dolosulaffinis-venezuelensis</i>	3 to 14/3 to 10	sympatric
<i>cubana-venezuelensis/hamulipenis-balzani</i>	3 to 14/5 to 11	sympatric

Table 10. Phylogenetic - distributional relationships of *Gaymara* sister lineages.

Sister Lineages	Geographical Areas	Distributional Relationships of Lineages
Species Groups		
<i>C. chlorosticta</i> group		
<i>C. chlorosticta/C. staudingeria</i>	4-5-7/4-5-7	sympatric
<i>C. nigroreticulata/</i> <i>C. paranigroreticulata</i>	4/4	allopatric
<i>chlorosticta-staudingeria/</i> <i>nigroreticulata-paranigroreticulata</i>	4-5-7/4	sympatric
<i>C. anulipes</i> group		
<i>C. anulipes</i>	4-5	
Early Lineages		
<i>chlorosticta-paranigroreticulata/</i> <i>C. anulipes</i>	4-5-7/4-5	sympatric

mainland populations of *viridicollis* group. (5) Post middle Tertiary dispersal of *hemichrysea* group stock across ocean into Central America and its diversification there, extinctions of elements on the South American mainland, and a Pleistocene reinvasion of *mendicula-sphaerodera* lineage into western Colombia. (6) Vicariance, dispersal and diversification from middle Tertiary through the Pleistocene by the *argentata* group, *aureola* group, *misella* group, and *minarum* group, within and among the three main centers of taxa concentration, northern South America (area 8, Guayana Shield), eastern Brazil (area 5, Brazilian Shield), and the Amazon basin (area 7), mainly in relation to expanding open forests and savanna and their intermittent intrusion into the Neotropical rainforests. (7) Pliocene vicariance of ancestral lineage of *C. nebulosa/mandli-insularis* by Andean orogeny in northwestern South America resulting in *C. nebulosa* west of the Andes and ancestor of *mandli-insularis* east of the Andes, and a Pleistocene founder dispersal by the latter across the Andes into middle America resulting in *C. mandli* and *C. insularis*.

Extensive sympatry among sister lineages obscures the geographical history of *Gaymara*. It is likely that southeastern Brazil was the region in which its diversification took place, given that all extant taxa exist there.

Distribution patterns of the taxa and phylogenetic-distributional relationships imply a general history for *Plectographa* in northern Argentina. Late Tertiary dispersals westward across the Andes by the ancestral stocks of

Table 11. Phylogenetic - distributional relationships of *Plectographa* sister lineages.

Sister Lineages	Geographical Areas	Distributional Relationships of Lineages
Species Groups		
<i>C. halophila</i> group		
<i>C. halophila</i>	3	
<i>C. suturalis</i> group		
<i>C. sinuosa/C. suturalis</i>	3-4/3 to 9-14-15	parapatric
<i>C. hirsutifrons/C. nivea</i>	3/2 to 5	allopatric
<i>C. ramosa/C. nahuelbutae</i>	3-4/1	allopatric
<i>hirsutifrons-nivea/ramosa-nahuelbutae</i>	2 to 5/1-3-4	sympatric
<i>sinuosa-suturalis/hirsutifrons-nahuelbutae</i>	3 to 9-14-15/1 to 5	sympatric
<i>C. siccalacicola/sinuosa-nahuelbutae</i>	3/1 to 9-14-15	sympatric
<i>C. melaleuca</i> group		
<i>C. ritsemai/C. drakei</i>	3/3	sympatric
<i>C. melaleuca/C. patagonica</i>	3-4/3-4	sympatric
<i>C. gormazi/C. chiliensis</i>	1-2/1-2	sympatric
<i>melaleuca-patagonica/gormazi-chiliensis</i>	3-4/1-2	allopatric
<i>ritsemai-drakei/melaleuca-patagonica-gormazi-chiliensis</i>	3/1 to 4	sympatric
<i>C. mixtula/ritsemai-chiliensis</i>	3/1 to 4	sympatric

(continued on next page)

Table 11 (continued)

Sister Lineages	Geographical Areas	Distributional Relationships of Lineages
<i>C. nigrovittata</i> group		
<i>C. nigrovittata</i>	5	
<i>C. apiata</i> group		
<i>C. eugeni/C. apiata</i>	3/3 to 6	sympatric
Early Lineages		
<i>siccalacicola-nahuelbutae/mixtula-chiliensis</i>	3 to 9–14–15/1 to 4	sympatric
<i>siccalacicola-chiliensis/nigrovittata</i>	1 to 9–14–15/5	sympatric
<i>siccalacicola-nigrovittata/eugeni-apiata</i>	1 to 9–14–15/3 to 6	sympatric

Table 12. Phylogenetic - distributional relationships of *Cylindera* sister lineages.

Sister Lineages	Geographical Areas	Distributional Relationships and Lineages
Species Groups		
<i>C. morio</i> group		
<i>C. kollari/C. malaris</i>	5-7/7	allopatric
<i>C. confluentesignata/</i> <i>C. granulipennis</i>	4-5/7	allopatric
<i>C. morio/C. marquardtii</i> <i>confluentesignata-granulipennis/</i> <i>morio-marquardtii</i>	5-7/5 4-5-7/5-7	sympatric sympatric ?
<i>kollari-malaris/</i> <i>confluentesignata-marquardtii</i>	5-7/4-5-7	sympatric
<i>C. friedenreichi</i> group		
<i>C. piligera/C. obsoletesignata</i> <i>C. friedenreichi/</i> <i>piligera-obsoletesignata</i>	5-7/3-4 4/3-4-5-7	allopatric allopatric
Early Lineages		
<i>kollari-marquardtii/</i> <i>piligera-friedenreichi</i>	4-5-7/3-4-5-7	sympatric

*melaleuca-patagonica/gormazi-chiliensis* and of *C. ramosa/C. nahuelbutae* resulted in the Chilean species *C. gormazi*, and the stock of *C. chiliensis/C. nahuelbutae* which diversified west of the Andes, and resulted in the latter sister species.

Sympatric relationships of sister lineages of relative early and intermediate age obscure historical events of *Cylindera*. Allopatric relationships of recent lineages however indicate the following events: (1) Pleistocene vicariance and diversification of stock of *C. kollari/C. malaris* caused by expansions of rainforest during an interglacial phase resulting in Amazon basin species *C. kollari* (east) and *C. malaris* (west). (2) Events as in (1) for stock of *C. confluentesignata/C. granulipennis* resulting in *C. confluentesignata* (east Brazil) and *C. granulipennis* (Ecuador). (3) Vicariance and diversification of ancestral stock of *C. friedenreichi/C. piligera-C. obsoletesignata* in southeastern Brazil during Pliocene or early Pleistocene, possibly as a result of habitat decrease caused by increased aridity in eastern Brazil, resulting in *C. friedenreichi* and stock of *C. piligera/C. obsoletesignata*, and vicariance of the latter resulting in *C. piligera* and *C. obsoletesignata*. (4) Dispersal of *C. piligera*



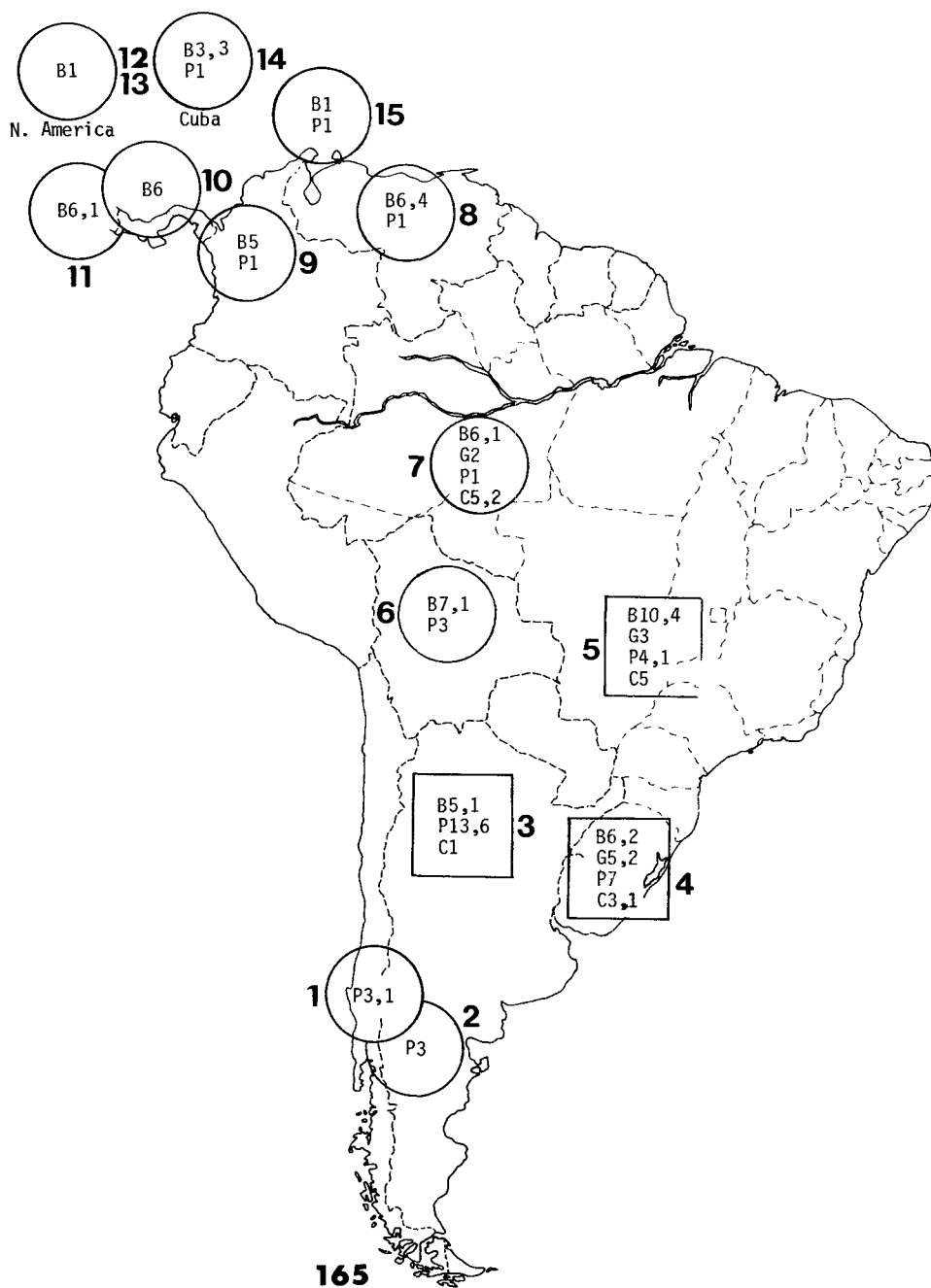


Fig. 165. Distribution of species of *Brasiella*, *Gaymaria*, *Leptographa*, and *Cyillindera* according to geographical area. Symbols: the number beside a circle denotes geographical area; squares and circles are major and minor centres of species concentration respectively; letters denote subgenus; first and second numbers beside letters denote number of species and endemic species respectively.

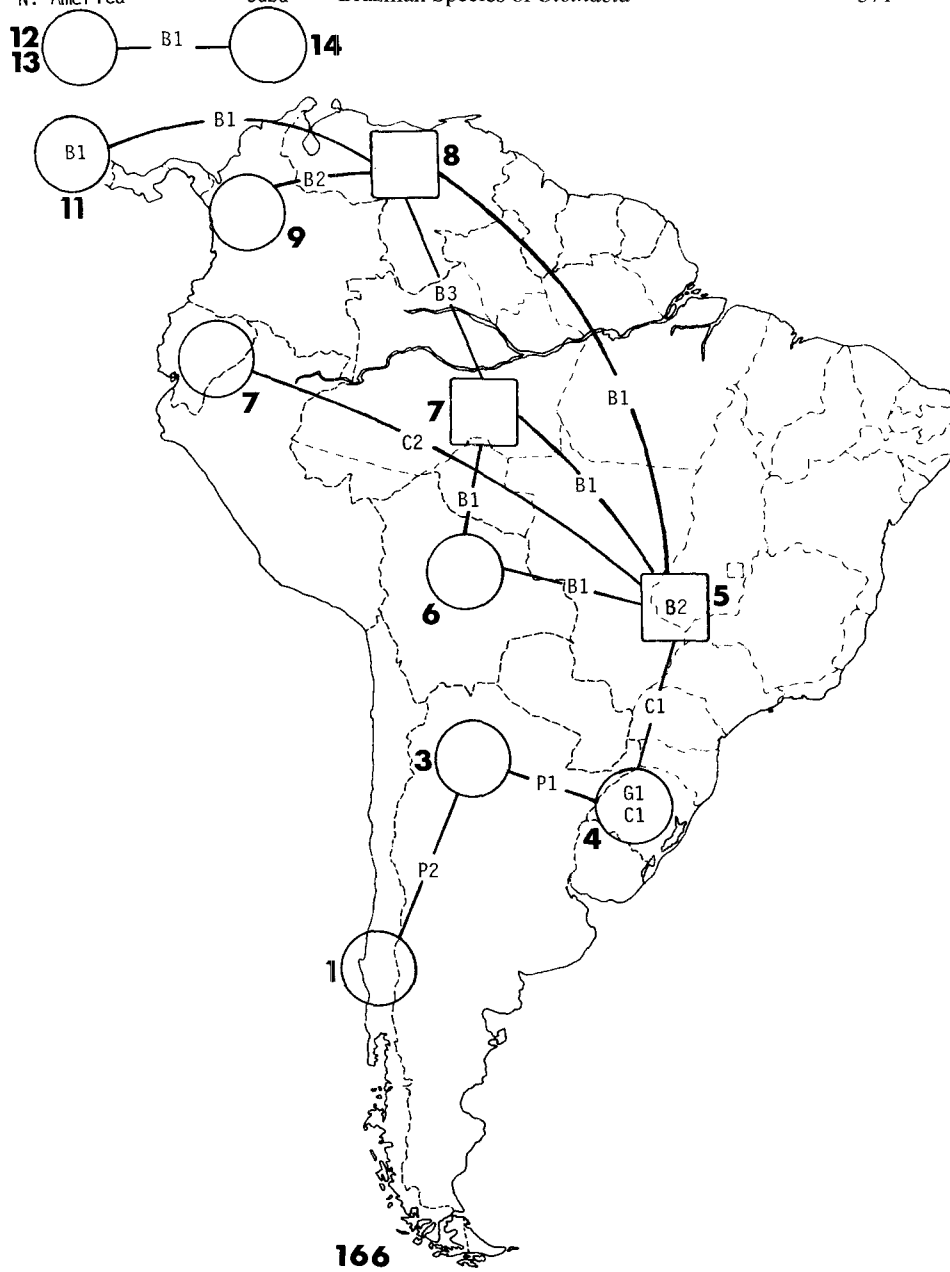


Fig. 166. Number of geographical relationships of allopatric sister lineages of *Brasiella*, *Gaymara*, *Plectographa* and *Cylindera*. Symbols: the number beside a circle denotes the geographical area; squares and circles are major and minor centres of species diversification respectively in designated geographical areas; letters denote subgenus; number beside letters denotes number of allopatric sister lineages, within (inside circles) or between (outside circle) geographical areas.

throughout the southern part of the Amazon basin during the last glacial episode, and its vicariance pattern recently caused by the spread of rainforest in the basin resulting in two allopatric populations, one in Ecuador and another in eastern Brazil.

### Summary

Origins of the four studied subgenera were in western Gondwana prior to the formation of South America, and subsequent Neotropical diversification within subgenera took place mainly in the northern half of South America.

Major centers of species concentration, or refugia, of *Brasiella*, *Gaymara* and *Cylindera* are in eastern Brazil south of the Amazon River basin and that of *Plectographa* in northern Argentina. These centers have been long standing, perhaps for the entire Cenozoic Era, given their mix of related and unrelated taxa of different phylogenetic age. They were the chief sources of dispersal during hospitable climatic and geophysical episodes, and into which taxa retreated during the hostile episodes.

Major barriers over or through which taxa periodically passed, became geographically isolated and diversified, include the Amazon basin, Andes in Chile and Colombia, and Tertiary Central America. At the present time members of many taxa pairs are found on opposite sides of any one of these barriers. Arid regions in central parts of northern Argentina, and Pleistocene marine incursions in northeastern Argentina (Noonan, 1985) may have been barrier effective in the diversification process of *Plectographa* lineages.

Climatic reversals resulting in vegetational changes in the Amazon basin during the last half of the Tertiary and Pleistocene were a fundamental cause of taxa formation. Open country conditions developing in glacial periods allowed general expansions of ranges into the basin. Division, isolation, and diversification of populations occurred with the return of humid tropical forests during interglacial periods.

### PROBLEMS AND PREDICTIONS

1. Definitive taxonomic positions of *C. stamatoivi*, *C. halophila*, *C. mixtula*, *C. nigrovittata*, *C. malaris* and *C. granulipennis* will be partly or wholly resolved by careful examinations of external and genitalic characters, and the reassessment of character weights.

2. Subgenus *Brasiella* species for which genitalic structures are not yet known, will have the flagellum absent from the male genitalia and the oviduct sclerite will be replaced by a membrane in females. Similarly, *Plectographa* species will have an elongate tooth with or without spatulate apex in males and ventral sclerite with two elongate posterior projections in females. Subgenus *Cylindera* species will have the central plate absent from males and ventral sclerite with two anterior lobes and two posterior projections in females.

3. The relationships analysis of *Cylindera* lineages is incomplete in the context of their New World history. Some South and North American taxa appear more closely related than we earlier suspected. This may be so for other groups not currently recognized as part of the *Cylindera* complex. One example is North American subgenus *Dromochorus* Guérin, the adults of which have a general habitus remarkably similar to those of the *morio* group.

4. This biogeography will change with changes in the reconstructed phylogeny or by geographical range extensions. The latter is likely to occur as new collections of specimens are made for taxa in areas peripheral to and within western parts of the Amazon basin. Until now that region has not been well collected, and what appear to be disjunct distributions may turn out to be more or less continuous geographical ranges. Candidates for range changes are *C. misella*, *C. dolosula* and *C. piligera*, among others.

5. Additional species of subgenus *Brasiella* that may be discovered will be in the New World, and mainly from eastern Brazil.

6. Additional species of subgenus *Gaymara* will be South American from southeastern Brazil.

7. Additional species of subgenus *Plectographa* will be from northern Argentina.

8. Additional South American species of *Cylindera* will be from eastern Brazil and the Amazon River basin.

9. It is evident that most species are closely associated with unforested regions. Many related taxa are divided by humid forests, particularly those of Amazonia. Dispersal routes followed by ancestors of these disjunct taxa have not been identified in our study. We do know that humid forests periodically gave way to grasslands and open country, but we do not know where they developed, and if there existed major and minor dispersal routes. In Webb's (1978) review of South American history of savanna vertebrates two major north-south routes are discussed, the Andes, "high road", and the Amazon basin "low road". Both routes were followed by non-forest vertebrate species. Taxa of *Brasiella* and *Cylindera* appear to form a composite geographical distribution pattern that coincides with the "low road". It extends from Colombia to southeastern Brazil through the western central and southern areas of the Amazon basin. Collections in western Brazil, Bolivia, Peru, and Ecuador will add distributional evidence in support of the Amazonian route for South American taxa of *Cicindela*.

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